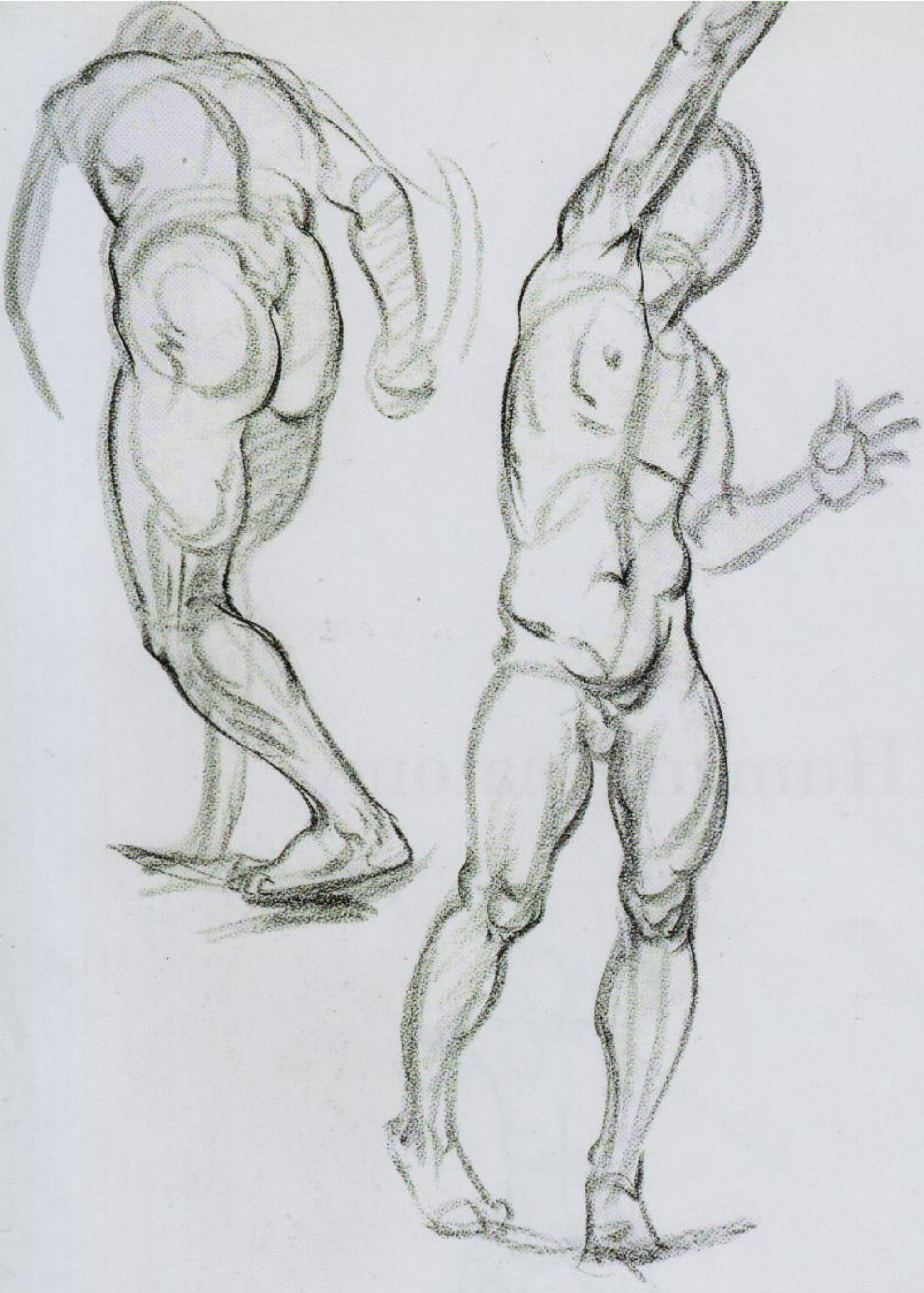
CLASSIC HUMAN ANATOMY

The Artist's Guide to Form, Function, and Movement

VALERIE L. WINSLOW

Please Purchase A Copy Of This Book: Keep Artists Making Great Books!



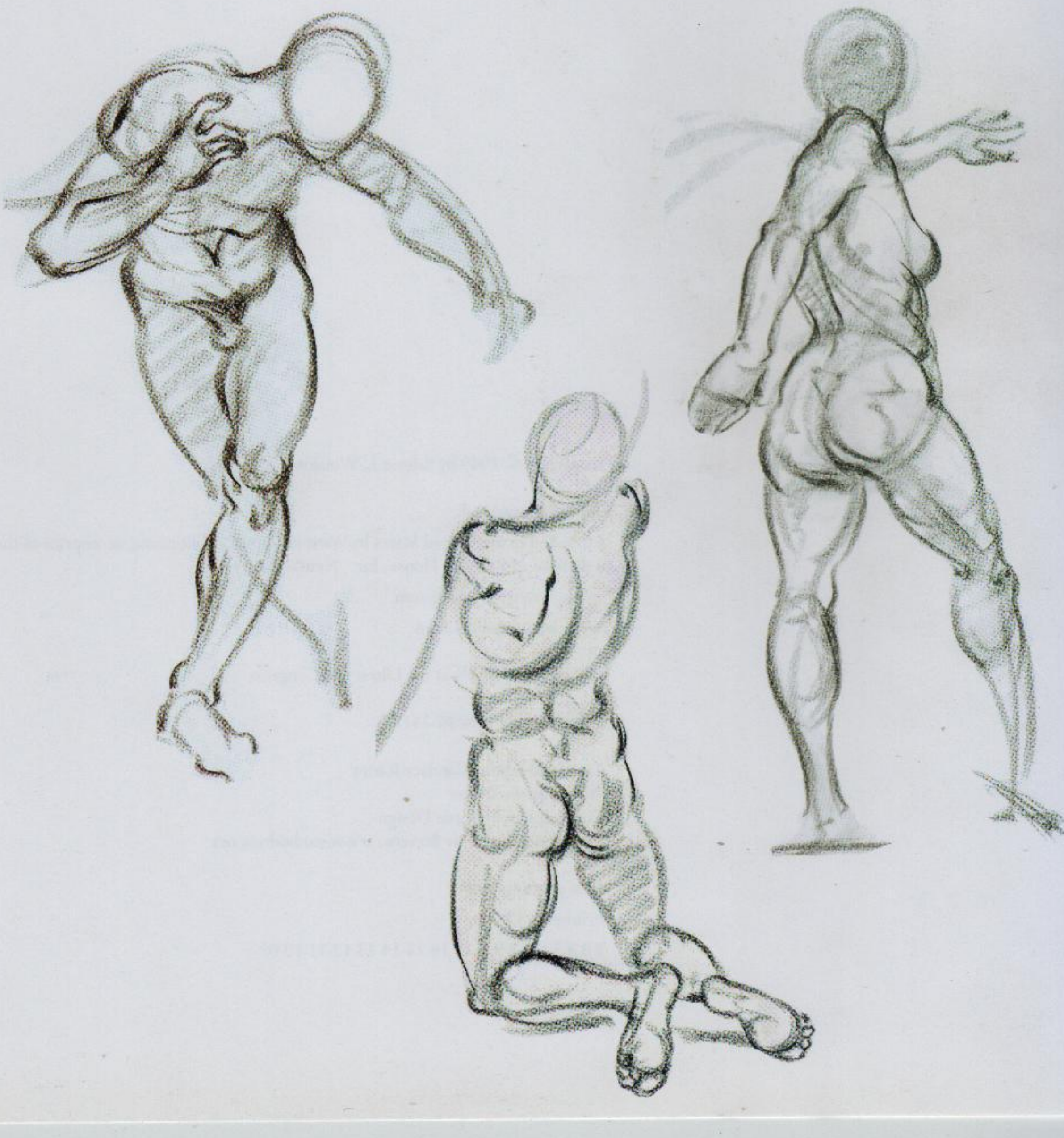
Classic

WATSON-GUPTILL
Watson-Guptill Publications
New York

VALERIE L. WINSLOW

Human Anatomy

The Artist's Guide to Form, Function, and Movement



Published in the United States by Watson-Guptill Publications, an imprint of the Crown Publishing Group, a division of Random House, Inc., New York.

www.crownpublishing.com

www.watsonguptill.com

CIP data is available at the Library of Congress

ISBN-13: 978-0-8230-2415-5

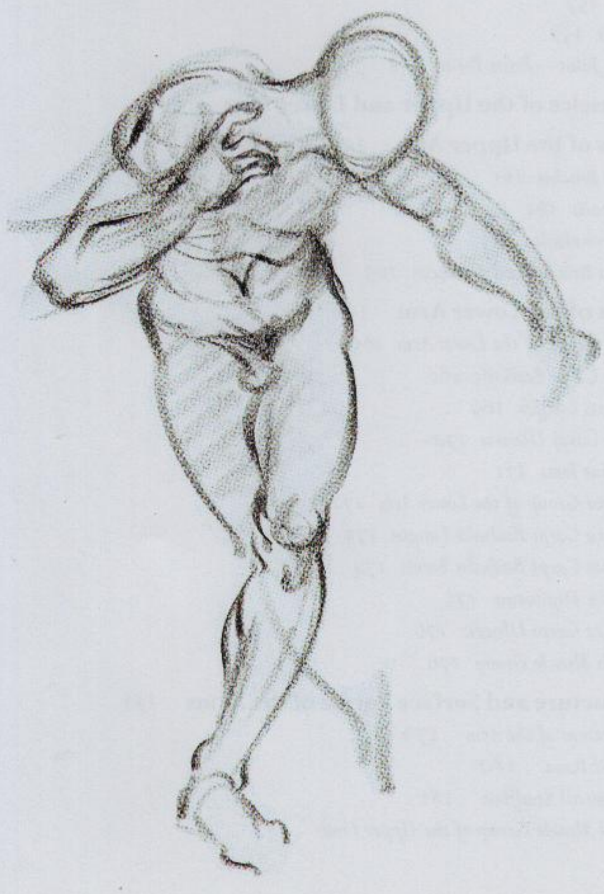
Executive editor: Candace Raney
Editor: James Waller
Cover design by Verde Design
Page design by Drew Stevens, www.studiodrew.net

First printing 2009

Printed in China

2 3 4 5 6 7 8 9 / 17 16 15 14 13 12 11 10 09

Contents



Acknowledgments 8

Preface 11

Introduction: Anatomy and Figurative Art 12

Chapter 1: The Language of Anatomy 20

The Structure of This Book *22*
Variations in Anatomical Nomenclature *23*
The Meanings of Anatomical Terms *23*
The Anatomical Position *24*
The Medial Line *27*
Anatomical Planes *28*
Sagittal Plane *29*
Coronal Plane *29*
Transverse Plane *29*
Anatomical Directions/Locations *31*
Terms for Anatomical Movements *31*
Movement Within the Sagittal Plane 32
Movement Within the Coronal Plane 34
Movement Within Transverse Planes 37
Movement Within All Three Planes 37
Special Anatomical Movements 38

Connective Tissues *40*
Cartilage 41
Ligaments 43
Tendons 45
Aponeurosis 45
Fascia 46
Subcutaneous Fat 47

The Skeletal System *49*
Skeletal Structure, Surface Form, and Movement 49
Bone Tissues 49
Axial Skeleton 52
Appendicular Skeleton 52
Classification of Bones by Shape 53
Surface Features of Bones 55
Joints 56

The Muscular System *61*
The Structure of Muscles 64
Muscle Names 65
Muscle Attachments—Origins and Insertions 65
Types of Muscle Fibers 66
How Skeletal Muscles Create Movement 66

Chapter 2: The Head, Face, and Neck 68

The Skull *70*

The Bones of the Skull *73*

The Bones of the Cranium 73
The Facial Bones 73
The Teeth 75
The Cervical Vertebrae of the Neck 76

The Muscles of the Head, Face, and Neck *77*

Masseter 80
Temporalis 81
Frontalis 82
Procerus 83
Orbicularis Oculi 84
Nasalis 85
Levator Labii Superioris Alaeque Nasi (LLSAN) 86
Orbicularis Oris 87
Levator Labii Superioris 88
Zygomaticus Major and Zygomaticus Minor 89
Depressor Anguli Oris 90
Depressor Labii Inferioris 90
Mentalis 90
Buccinator 92
Mylohyoid and Digastric Muscles 92
Sternocleidomastoid 94

The Structure and Surface Forms of the Head, Face, and Neck *96*

Central Axis of the Head 96
Planes of the Head 96
Proportions of the Head 97
The Neck—Structures and Forms 99

The Features of the Face *101*

The Eyes 101
The Nose 104
The Lips and Mouth Region 105
The Ears 106

Chapter 3: The Torso 108

The Bones of the Torso *110*

Vertebral Column 113
Thorax/Ribcage 115
Sternum 116
Clavicles 117
Scapula Bones (Scapulae) 118
Shoulder Girdle 119
Pelvis 120

The Muscles of the Torso *122*

Sacrospinalis 125
Pectoralis Major 126
Deltoid 128
Trapezius 130
Rectus Abdominis 132
External Oblique 134
Serratus Anterior 136
Latissimus Dorsi 138
Rhomboid Major and Rhomboid Minor 140
The Scapula Group 142

The Structure and Surface Forms of the Torso *144*

Axes of the Torso 144
Canons of the Torso 146
Setting Up the Torso 148
The Rotating Torso 150
Axilla (Armpit) 151

Chapter 4: The Arm 152

The Bones of the Upper and Lower Arm *154*

Humerus 157
Ulna 157
Radius 157
Elbow Joint—Basic Forms 158

The Muscles of the Upper and Lower Arm *159*

Muscles of the Upper Arm *159*

Biceps Brachii 161
Brachialis 162
Brachioradialis 163
Triceps Brachii and Anconeus 165

Muscles of the Lower Arm *166*

Flexor Group of the Lower Arm 166
Flexor Carpi Radialis 168
Palmaris Longus 169
Flexor Carpi Ulnaris 170
Pronator Teres 171
Extensor Group of the Lower Arm 172
Extensor Carpi Radialis Longus 173
Extensor Carpi Radialis Brevis 174
Extensor Digitorum 175
Extensor Carpi Ulnaris 176
Thumb Muscle Group 176

The Structure and Surface Forms of the Arms *178*

Proportions of the Arm 179
Cubital Fossa 180
Anatomical Snuffbox 181
Radial Muscle Group of the Upper Limb 181

Chapter 5: The Hand 182

The Bones of the Hand *184*
- *The Carpal Bones 186*
- *The Metacarpals 186*
- *The Phalanges 186*
- *The Joints of the Hand 187*

The Three Muscle Groups of the Hand *188*
- *Thenar Group 190*
- *Hypothenar Group 191*
- *Interosseous Muscle Group 192*

The Structure and Surface Forms of the Hand *193*

Proportions of the Hand *194*

Characteristics of the Fingers *196*

Characteristics of the Skin on the Hand *196*

The Fingernails *198*

Hand Grips *198*

Chapter 6: The Leg 200

The Bones of the Leg *202*
- *Femur 203*
- *Tibia and Fibula 204*
- *Knee Joint 205*

The Muscles of the Leg *206*

The Muscles of the Upper Leg *206*
- *Quadriceps Group 208*
- *Sartorius 210*
- *Adductor Group 210*
- *Hamstring Group 212*
- *Gluteal Group 214*

The Muscles of the Lower Leg *216*
- *Tibialis Anterior 217*
- *Extensor Digitorum Longus 217*
- *Extensor Hallucis Longus 218*
- *Gastrocnemius and Soleus 219*
- *Peroneus Longus and Peroneus Brevis 221*

The Structure and Surface Forms of the Legs *222*
- *Proportions of the Leg 222*
- *Angles and Rhythm of the Leg 222*
- *The Knee Region 224*
- *Pes Anserinus, or Goosefoot 225*
- *Popliteal Fossa 225*

Chapter 7: The Foot 226

The Bones of the Foot *228*
- *Tarsals 230*
- *Metatarsals 231*
- *Phalanges 231*

The Arches of the Foot *232*

The Muscles of the Foot *233*
- *Extensor Digitorum Brevis 234*
- *Abductor Hallucis 234*
- *Abductor Digiti Minimi 234*
- *Flexor Digitorum Brevis 236*
- *The Action of the Muscles of the Foot 236*

The Structure and Surface Forms of the Foot *237*
- *The Sole of the Foot and the Foot Pads 238*
- *Basic Form of the Foot 238*
- *Planes of the Foot 239*
- *Proportions of the Foot 240*
- *Characteristics and Rhythm of the Toes 240*

Chapter 8: The Whole Figure 242

Gesture/Action Drawing of the Figure *244*

The Structure of the Whole Figure *246*

The Proportions of the Whole Figure *249*
- *Why Learn a Proportional System? 250*
- *The Standard Canons of Proportion 250*
- *The Eight-Head Proportional System 252*
- *The Seven-and-a-Half-Head Proportional System 254*
- *The Proportional System of Divisions 256*
- *Proportional Breakdowns of the Arms and Legs 258*
- *Widths of Body Parts 259*

Body Heights and Body Types *260*

Rhythm of Forms in Figure Drawing *262*

Anatomical Terminology Reference Guide 264

Glossary 277

Suggested Reading 295

Index 297

BACK VIEW, STANDING WOMAN

Acknowledgments

I first want to give very special thanks to Watson-Guptill Publications senior editor Candace Raney for her enthusiastic support and for giving me the opportunity to fulfill one of my dreams—the publication of my anatomy book. To my editor, James Waller, I extend my most heartfelt thanks for his intelligent and critical observations, suggestions, and recommendations. His wonderful gentle wit and professionalism made the whole editorial process a somewhat pleasurable experience. To designer Drew Stevens, I express much admiration for his incredible work in the overall design and layout. I also extend my appreciation to the many talented people at Watson-Guptill with whom I worked, including production director Alyn Evans, managing editor Brian Phair, and production manager Sal Destro.

I also want to express my sincere gratitude to Dr. Elisa Stephens, president of the Academy of Art University, and to Richard A. Stephens, chairman, for their wonderful support and for letting me teach the subject I love most—the anatomy of the human figure. To Craig Nelson, department chair of the School of Fine Arts at the Academy of Art University, I extend my appreciation for his professional friendship and for his continued support of the anatomy classes at the AAU School of Fine Arts.

To my very special friends Joy von Wolffersdorff, Carol Nunnelly, Oteino Vumapile, and John Dubiel: I am most grateful for your genuine support, your words of encouragement, and your compassionate understanding over the years.

Special thanks also go to Dorothy Burk, PhD, associate professor and chair, and to Gary Richards, PhD, adjunct assistant professor and laboratory manager, both of the Anatomy Department of the University of the Pacific's Arthur A. Dugoni School of Dentistry. I appreciate their incredible patience in answering my endless anatomical questions and for allowing me and my students the unique opportunity of observing and drawing cadavers from their department's dissection laboratory.

Much gratitude also goes to the people who helped me track down and obtain permissions to reproduce the historical images in this book's introduction: Crystal Smith, reference librarian; Dr. Stephen Greenberg, reference librarian; and Michael J. North, head of rare books and early manuscripts, all of the History of Medicine Division of the National Library of Medicine in Bethesda, Maryland; Toby Appel, head librarian, and Florence Gillich, library assistant, both of Harvey Cushing/John Hay Whitney Medical Historical Library, Yale University; and Lucie Strnadova and Louise Oliver, picture library assistants at the Royal Collection Picture Library at St. James's Palace, London.

I also extend much appreciation and gratitude to Ronnie A. Roche, the "Mac Goddess of the West Coast," for helping me learn to transform my anatomical drawings into a digital format. And I give special thanks to photographer Owen Kahn for his skill in shooting my large anatomical drawings as well as for his continued support and appreciation for my art.

Finally, I owe thanks to Rob Anderson; attorney M. J. "Bo" Bogatin; Tim Bradley; Jony Chandra; Marion Christian; Thomas Cohn, MLIS; Lloyd Cole; Tom Conville, Grace Fau; Colleen Flannary; Marlee Frazee; Kinnari Gosalia; Joshua Hammer, DMD; Mel Hoffman; Michael Holmes; Sheri Johnsen; Andrew Kawrse; Tom Kennedy; Wendy Larick; Gregory Longfellow; Douglas Malone; Tony Moore; Amy Morrell; Marilyn Paine; Sunil Pant; Mia Paschal; Stephen Perkins; Brandon Pike; Pamela Powell; Pablo Rodriquez; Molly Rose; Bill Sanchez; Andrea Sendek; Theresa Shugue; Dan Tanaka; Constance Taylor; Suzanne Taylor; Claudio Tudisco; and Lucille von Wolffersdorff, as well as to all the students I've had the incredible pleasure of teaching over the last three decades.

NUDE FIGURE, FRONTAL TWIST

Preface

For many centuries, anatomy has been considered one of the most challenging subjects for artists to master. Anatomical studies were a vital part of the traditional figurative artist's curriculum in most art instruction of the past, and learning anatomy was considered essential to successfully depicting the human figure.

At the cusp of the twentieth century, attitudes within the art world began to shift, and anatomical training for artists began to be viewed as cumbersome and antiquated. Anatomy instruction was gradually phased out in many art departments and schools, with only a few ateliers and private art academies offering training in this complex topic.

In the last several years, however, there has been a resurgence in the appreciation of artistic anatomy. A variety of artists—including traditional fine-art painters and sculptors, illustrators and animators, and creators of high-tech digital imagery—are rediscovering anatomy's importance. Knowledge of anatomy enhances the ability to depict the human figure, regardless of the artist, medium, technique, or style.

My own passion for anatomy was ignited when I, as a young art student, discovered a large, leather-bound book containing 103 facsimiles of drawings by Michelangelo. The exquisite beauty of the anatomical forms was captivating and inspired me to begin my studies in this area. During my early training, though, I was frustrated by my figurative-art instructors' lack of knowledge of, or passion for, anatomy. Too many artists shunned the subject because it was no longer considered necessary for artistic training, and I found no one to sustain my growing interest in the muscular and skeletal structures of the human body.

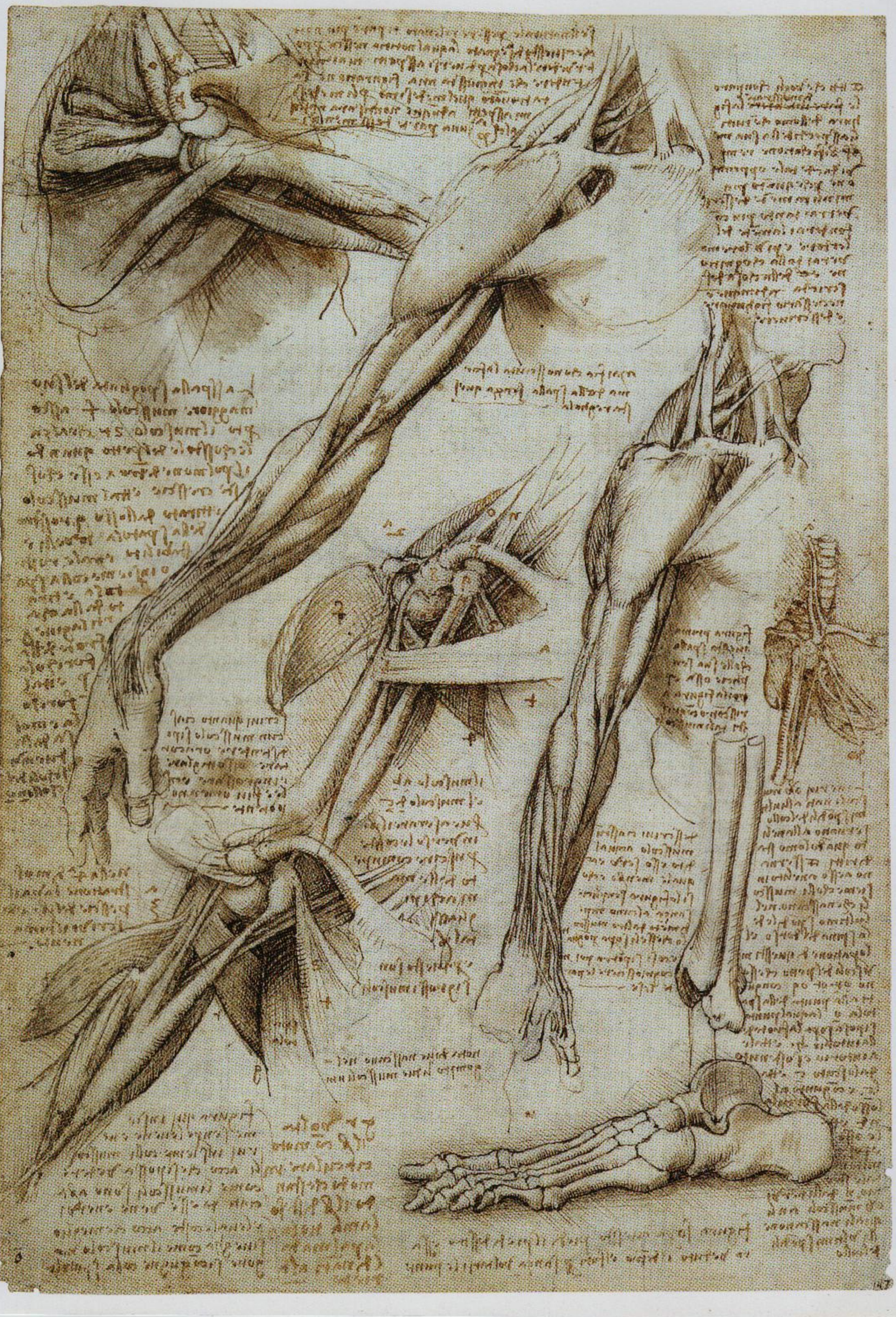
That situation changed when I met and began working with an exceptional teacher: the renowned Hard Edge and post-Surrealist painter Lorser Feitelson. Lorser's figure drawing had the intensity and power of a Renaissance master's, and he became a beloved mentor, encouraging me to continue my quest for anatomical knowledge. Through his influence and my own diligence, I became more and more aware of anatomy's fascinating influence on figurative art. My career as a professional fine artist saw the gradual infiltration of anatomy into my own work. I applied it with increasing intensity to my figure drawing and, with more restraint, to my figurative painting. Anatomy became—and remains—key to all my creative work.

As an educator specializing in classical figure drawing—and armed with my knowledge of anatomy—I help other artists understand and depict the human figure using techniques that will ultimately enhance their personal artistic visions. I occasionally encounter students who think that the study of anatomy might impinge on their creativity. Once they understand the basic anatomical forms, however, they soon realize that the study of anatomy helps eliminate guesswork and gives them the ability to approach drawing with more confidence and skill. This new awareness of anatomy does not just enhance the skills needed for drawing, painting, and sculpting the human form from life but also dramatically improves the ability to depict the figure from memory when no models are at hand. And the study of anatomy provides the artistic freedom to pursue a more traditional direction or to break away and explore alternative interpretations of the human form.

One of my objectives in writing this book was to present complex material in an "art friendly" format while staying true to the established anatomical system created by the medical profession. I also felt the need to demystify and decode anatomical terms so that they feel less intimidating to those approaching artistic anatomy for the first time. Artists' objectives for learning human anatomy are vastly different from those of medical professionals, yet the terminology, derived largely from Greek and Latin, remains the same in both fields. The first chapter of this book is, in essence, an artist's Rosetta Stone designed to help decipher these words.

The chapters following chapter 1 do not have to be read in sequential order. Chapters 2 through 7 concentrate on particular regions of the body, introducing each region's basic skeletal and muscular structures. The movements of individual muscles are also presented, to provide information that may be particularly useful for artists working with the animated figure. The final chapter focuses on the entire figure, emphasizing construction, proportional breakdowns, the rhythm of the human figure's forms, and the dynamics of gesture drawing. The anatomical terminology reference guide and glossary in the back of the book summarize, clarify, and in some cases expand on the information presented in the book's chapters.

While writing and illustrating this book, I accumulated an enormous amount of research material from various medical and artistic anatomy books and made thousands of studies based on live models and on human cadavers and natural bone skeletons. *Classic Human Anatomy* presents what I regard as the fundamental elements of artistic anatomy. Professional artists and students alike may focus on whatever is relevant for their own artistic goals. It has been my aspiration to help you better achieve those goals.



Introduction Anatomy and Figurative Art

Artists have always challenged themselves to depict the most demanding of all subjects—the human figure. As portrayed in painting and sculpture, the human figure has gone through many transformations throughout history, and artists' awareness of anatomical forms has greatly influenced the manner and style of figurative art. The degree to which anatomical considerations have played a role in a given artist's work has depended on the style of the period in which the artist was working, on the availability of systematic anatomical knowledge to the artist, and even on whether the artist has *wanted* to integrate this information into his or her art.

Even without formal study of anatomy, artists' awareness of the body's bony landmarks and the shapes of various muscular forms will infiltrate their work to some extent. But a real understanding of human anatomy has allowed artists to carry the depiction of the body to a more creative level. Historically, artists have time and again realized that knowledge of anatomy is a powerful key to representing the human figure in a more realistic and convincing manner.

From ancient times on, master artists who understood human anatomy and employed it in their work passed this knowledge on to the apprentices studying and working in their studios. Although many of the techniques developed in studios were preserved for the next generation of artists, some information was lost, discarded, or hidden "underground." The reasons for the periodic loss of anatomical knowledge are many—government upheavals, financial crises, wars, plagues, changes in religious and moral codes, and shifts in fashion and taste. Sometimes, the reason has been a simple lack of interest among upcoming artists in pursuing the same styles as their predecessors. This ebb-and-flow pattern, in which the influence of anatomy on figurative art has surfaced, gone underground, and then resurfaced, has played an important part in defining the various movements of art over the centuries.

As artists continue to create, there will undoubtedly be many more innovative transformations. And in the future as in the past, anatomy will remain an important source for artists' understanding of the incredibly complex and dynamic structure of the human body.

Studies of the Anatomy of the Shoulder and the Foot *(1510), by Leonardo da Vinci. Pen and ink with wash over black chalk. This exquisite set of écorché studies of the shoulder and arm, along with a study of the bones of the foot, are masterfully rendered with meticulous detail. The page is filled with Leonardo's observations and comments, in his characteristic "mirror" writing. The Royal Collection © 2008, Her Majesty Queen Elizabeth II.*

The Evolution of Anatomical Science

Hippocrates, Galen, and Avicenna. *This is a detail from a charming woodcut print that appeared on the title page of the third volume of a Latin translation of Galen's writings published in Lyons in 1528. The image shows the printmaker's vision of the three medical authorities whose anatomical writings so influenced Renaissance anatomists and artists. Courtesy of the National Library of Medicine.*

Human beings' knowledge of anatomical forms dates back to prehistory, arising as people learned to set bone fractures, attempted to cure diseases, and assisted mothers in childbirth. At its beginnings, medical knowledge was intertwined with religion and magic. The priests, priestesses, shamans, and sages of prehistoric times were their cultures' healers—the earliest physicians. Their sacred knowledge, including information about the human body's internal mechanisms, was passed on from generation to generation by word of mouth.

As written language replaced oral tradition, medical information began to be documented—on clay tablets, on papyrus scrolls, in parchment books, and, eventually, on paper. Most of the great centers of learning that arose in the Mediterranean world during ancient times included some kind of medical school. As scholarly treatises on medical topics accumulated, libraries were established to house these and other writings, which were disseminated through handwritten copies made by scribes.

With the collapse of the Roman Empire (476 CE), however, many libraries were destroyed. Some of the ancient medical texts were lost forever, although others survived in places far removed from their origins—to make their way back to Europe centuries later. In the Islamic world, Muslim and Jewish scholars preserved and translated many of the ancient Greek medical manuscripts. These scientific writings influenced Muslim physicians, who augmented the knowledge with their own medical observations and discoveries. The great Persian physician and philosopher Avicenna (Ibn Sina) (980–1037 CE) based his *Canon of Medicine* on the ancient teachings of Aristotle and Galen; his book later made its way to Europe, where, in Latin translation, it became very influential.

As ancient texts, many of them preserved by Muslim scholars, began to resurface in Europe during the medieval period, they ignited European curiosity about classical philosophy, mathematics, and medical science, including anatomy. In early medieval times, European monasteries and universities had carried on systematic copying of Greek and Arab scholarly writings into Latin. The knowledge found in these translated manuscripts profoundly influenced the European medical profession during the Renaissance. Belgian physician Andreas Vesalius (1514–1564), working in Italy, conducted his own anatomical investigations, performing numerous dissections. His remarkable, seven-volume anatomical atlas, *De Humani Corporis Fabrica* (*The Fabric of the Human Body*), is still marveled at today, especially by figurative artists.

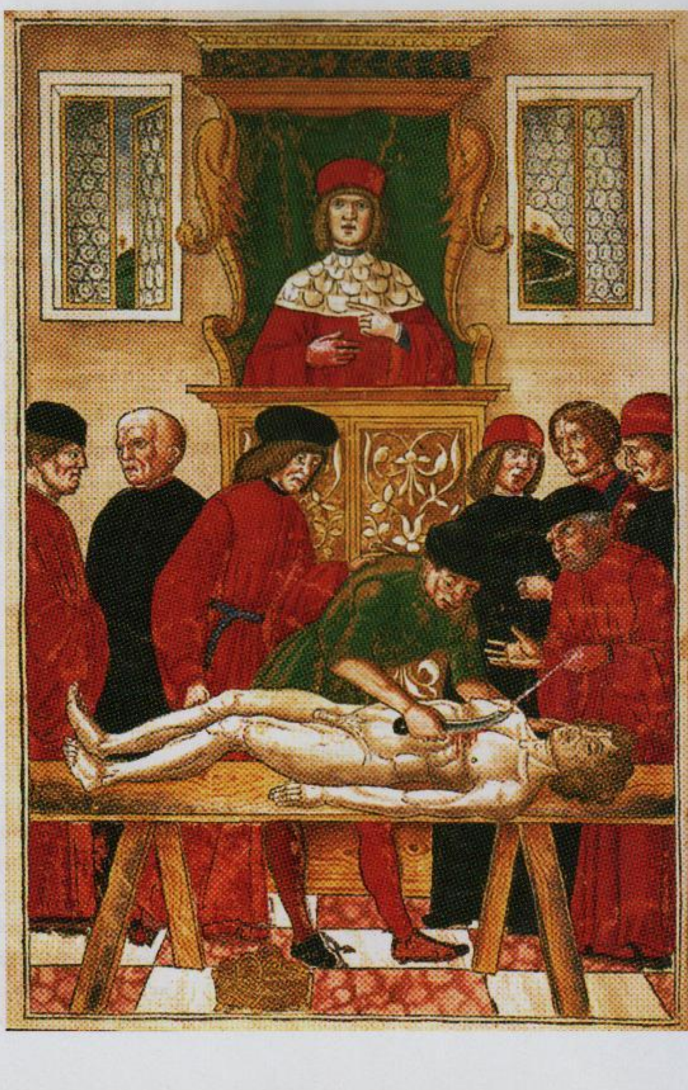
Vesalius was not alone. Other anatomists, surgeons, and physicians—likewise influenced by Greek and Islamic medicine—were also performing dissections, making medical discoveries, and publishing their work. By the sixteenth century, the invention of the printing press had made printed anatomical atlases widely available. The écorché plates (anatomical representations of all or part of the body with the skin removed to allow study of the underlying musculature) that appeared in these atlases, along with public access to anatomy theaters to witness dissections, caused the influence of medical anatomy on figurative art to surge.

During the early Renaissance, artists who wanted to learn about human anatomy had to do so under the tutelage of the medical profession. But, with some exceptions, painters and sculptors were not interested in anatomy as a science but rather as an aid to pictorial representation of the human body. It was because of this that, in the sixteenth century, Italian art academies (followed by others throughout Europe) began teaching an artistic approach to anatomy. The rationale was to help painters and sculptors to perfect their skill in depicting the human figure. From then on—through the late nineteenth century—most art academies provided intensive "classical" training, which included drawing from replicas of ancient sculptures and from live models as well as classes in perspective, composition, and artistic anatomy.

Until the nineteenth century, women had little opportunity to study art or anatomy at masters' studios, art academies, or universities. The few exceptions were women with family connections or who were financially independent. (Italian Baroque painter Artemisia Gentileschi [c. 1593–after 1652] studied under her father, Orazio Gentileschi, in his studio. American Impressionist painter Mary Cassatt [1844–1926] was able to study on her own in Europe because of her family's wealth.) When the art academies finally opened their doors to women in the mid- to late nineteenth century, the women were segregated from the men and were not allowed to attend figure drawing and anatomy classes. Only gradually were they granted the right to pursue artistic training, including the study of anatomy, on the same level as their male counterparts.

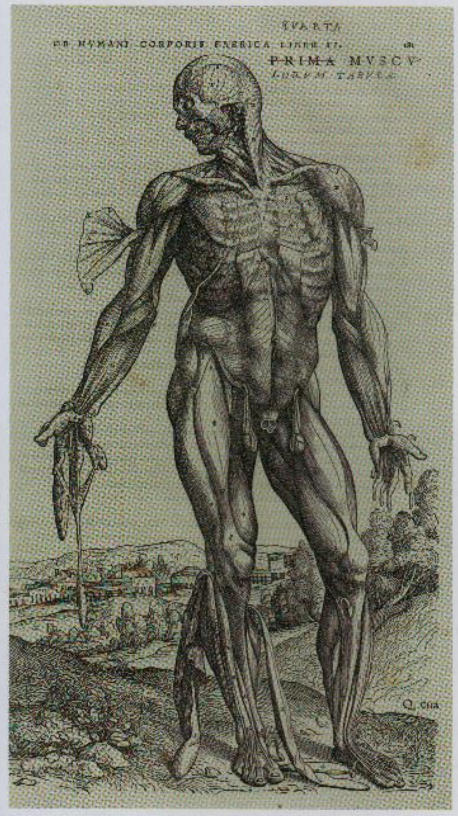
At the turn of the twentieth century, emerging American and European artists shifted away from classically influenced figurative art in favor of new and innovative ways of making images. There was an avalanche of different movements and techniques—all of which, however, rebelled against the traditional approach to art and art instruction. As a result, many art schools and art departments deemed anatomy classes unimportant and slowly phased them out during the mid- to late twentieth century. Classical training in anatomy and figurative art did survive, though only at a few schools and in private classes given by artists at their ateliers.

While the avant-garde artistic styles were flourishing, traditional figurative knowledge was kept alive by those artists—including portrait artists, illustrators, animators, and comic book artists—who depicted the figure realistically. Figurative painters and sculptors had a hard time of it: Museum curators and gallery owners often rejected their work in favor of abstract and conceptual art. But as the twentieth century drew to a close, an appreciation for traditional figurative art reemerged, as can be seen in the work of contemporary Realist painters such as Alan Feltus, Lani Irwin, Edward Schmidt, Martha Mayer Erlebacher, and Steven Assael and sculptors such as Martine Vaugel, Don Gale, Eric Goulder, and Richard McDermott Miller, to name but a few.



A Dissection Scene. *This hand-colored woodcut appeared in Johannes de Ketham's* Fasciculo di Medicina, *published in Venice in 1493. It depicts the fourteenth-century anatomist Mondino de Luzzi (Mondinus), who lectures from a high pulpit (cathedra) while an assistant, holding a pointer, shows the barber-surgeon where to cut the cadaver. Courtesy of Yale University, Harvey Cushing/John Hay Whitney Medical Library.*

The Study of Anatomy through Dissection



Muscles of the Body, Superficial Dissection, Anterior View *by Jan Stephan van Kalkar (Stephan van Calcar) and the workshop of Titian. This woodcut of an elegantly posed écorché figure is a plate from an edition of Andreas Vesalius's* De Humani Corporis Fabrica (The Fabric of the Human Body) *published in Basel in 1543. The illustrations from Vesalius's remarkable atlas, particularly those appearing in the first two volumes (on the bones and the muscles) have inspired and influenced figurative artists for hundreds of years. Courtesy of the National Library of Medicine.*

The ancient Egyptians had extensive knowledge of the internal structure of the body because of their embalming techniques. The meticulous procedures by which they prepared the dead for burial enabled them to preserve body tissues and gave them an understanding of the locations of many internal organs. Ancient Greek scholars, well aware of the Egyptians' knowledge of the human body, conducted their own investigations. Hippocrates (c. 460–377 BCE), Aristotle (384–322 BCE), and, later, the physician Galen (129–c. 199 CE) developed the science of anatomy further by dissecting animals to gain an understanding of how the internal organs, muscles, and bones functioned.

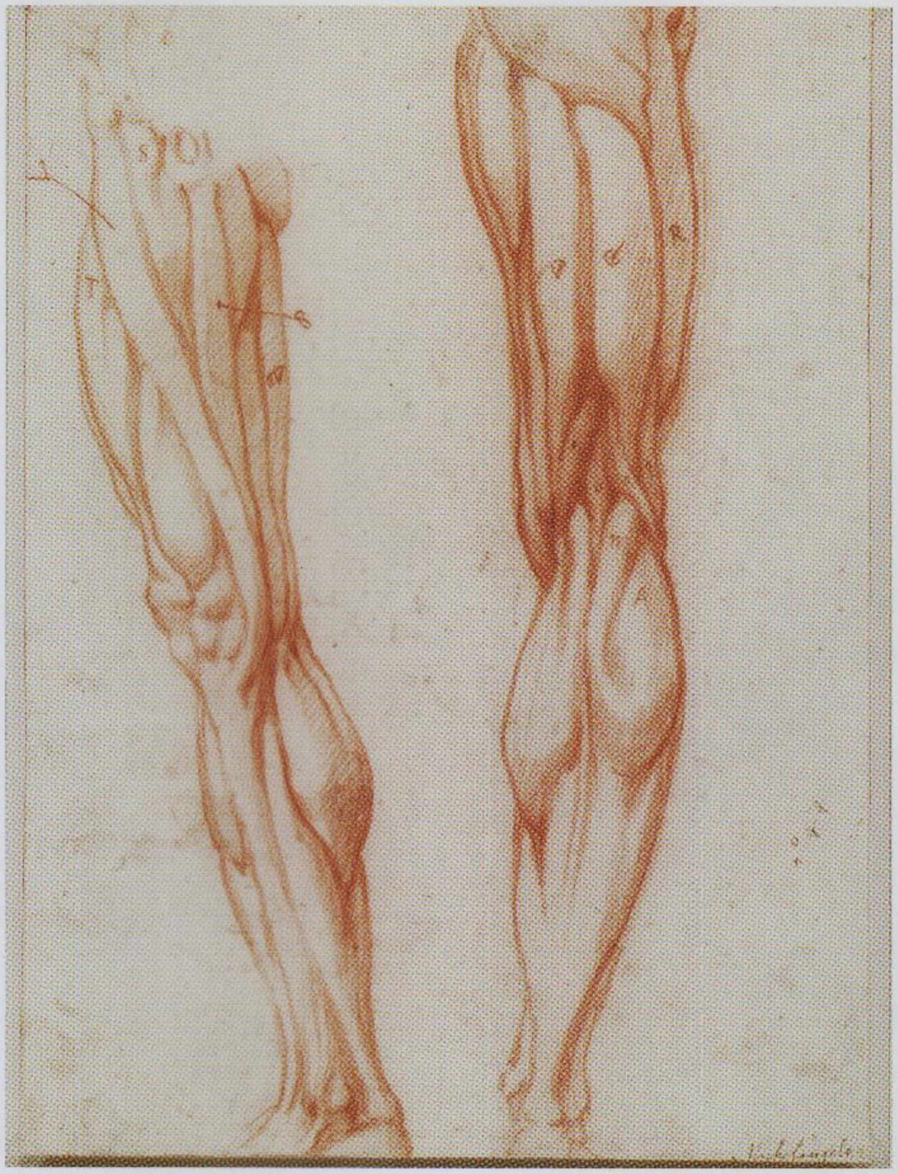
Alexandria, Egypt—a cultural center renowned for its library—attracted many scholars, who conducted research in a diversity of disciplines, including mathematics, astronomy, geometry, and medicine, including anatomy. The anatomy teacher Herophilos (c. 335–c. 280 BCE) dissected human cadavers there more than two thousand years ago. But Alexandria's famed library was ultimately destroyed, and the scholarly works, including anatomy texts, that had been kept there were burned or plundered.

Following the fall of the Roman Empire, much of the classical Greek and Roman knowledge about human anatomy and the depiction of the human figure was lost. As the religious and political climate of Europe changed, official tolerance of dissections waned. Hundreds of years would pass before medical and anatomical research recommenced.

Medieval Europe's first medical school was established in Salerno (Schola Medica Salernitana), in southern Italy, in about 900 CE. The Salerno Medical School became well known for teaching anatomy as part of its surgical training and for including women physicians on the faculty. Salerno's innovations influenced many other universities with medical schools, including those in Bologna, Padua, Paris, and Montpellier, which also offered anatomy training as part of their curriculum.

It wasn't until the thirteenth century, however, that the Roman Catholic Church permitted the dissection of human cadavers for medical research purposes. These anatomical dissections, conducted by a surgeon-anatomist, were held in university settings and later in public and semipublic forums called anatomy theaters. Although anatomical atlases and écorché models cast in colored wax (through a process called ceroplasty) became more widely available during the Renaissance, many artists believed that witnessing actual human cadaver dissections was the best way to learn about complex anatomical structures. Italian artists Antonio Pollaiuolo (c. 1431–1498), Luca Signorelli (c.1445–1523), and Michelangelo (1475–1564) and German artist Albrecht Dürer (1471–1528) all had the opportunity to dissect or observe dissections of cadavers. Artist, inventor, and scientist Leonardo da Vinci (1452–1519) made many new discoveries through his own meticulous dissections of human cadavers, and the drawings that he created based on his investigations are considered masterpieces. Leonardo's anatomical observations took the science of anatomy well beyond the ancient Greek texts that were influencing many artists and physicians of his time.

Over the following centuries, the dissection of human cadavers continued to go in and out of favor as attitudes and opinions changed. Even when dissection was officially permitted,



The Muscles of a Male Leg *(c. 1518), by Michelangelo Buonarroti. Red chalk. Michelangelo's anatomical analysis of a male leg in two different views reveals the artist's powerful understanding of how the muscles attach on the bones in a three-dimensional, sculptural manner. The Royal Collection © 2008, Her Majesty Queen Elizabeth II.*

it was an unpleasant task. Without refrigeration or other methods of preservation, specimens decomposed quickly. Between the thirteenth and the early nineteenth century, dissections were usually performed in winter, when the decomposition process was slowed by the cooler temperatures. There were attempts to preserve specimens in alcohol or certain oils to delay the process of decay, but the dissection and study of a fresh cadaver was always a race against time. Moreover, finding fresh cadavers was a challenge, because only the bodies of executed criminals could legally be used for dissection.

Artists, especially, had difficulty acquiring cadavers for study unless they had a connection at a medical school or morgue. Some went to great lengths to pursue their anatomical research, even obtaining decaying body parts to study in their studios, thereby putting their health at risk. French Romantic painter Théodore Géricault (1791–1824) made numerous studies from cadavers he observed in the dissecting rooms of the Beaujon Hospital in Paris. But he also enlisted the help of friends in medicine to obtain severed human heads and dissected limbs, which he drew and painted in his studio until they decomposed.

Cadavers for anatomical study were often acquired through unsavory means. A chronic shortage of cadavers in America and Great Britain during the late eighteenth and early nineteenth centuries sometimes led medical-school anatomists to hire men to steal bodies, creating a lucrative trade in grave robbing. The men who illegally confiscated freshly buried bodies from cemeteries were called body snatchers, "sack 'em up" men, and resurrectionists. Their unscrupulous occupation was halted only by the passage of laws allowing doctors and anatomists to obtain unclaimed bodies from workhouses and hospitals.

During the late nineteenth and early twentieth centuries, the development of embalming chemicals and then refrigeration allowed bodies to be preserved for a longer time. These technologies were followed, in the late twentieth century, by a preservation process called plastination, in which tissues are infused and hardened with polymers that preserve the body indefinitely and allow cadavers to be permanently posed in various positions. Currently, a number of large-scale exhibitions of plastinated bodies travel to science and natural history museums and other venues around the world, giving the public at large an unprecedented look at human anatomy.

STANDING FIGURE, TWISTING

Studying Artistic Anatomy Today

If an opportunity to witness a cadaver dissection arises through a specialized workshop or a class offered through university or medical school, you might consider enrolling. Seeing actual muscles revealed three-dimensionally can be an extremely valuable experience. That said, it's no longer absolutely necessary for artists to attend dissections, because there are so many resources available for the study of artistic anatomy. These tools include the following:

- Traditional anatomy books and charts.
- DVDs with digital images of skeletal and muscular structures allow the user to manipulate images, moving figures into various positions to observe the mechanics of anatomy. DVDs are also available that show various sections of dissected cadavers.
- Plastic reproductions of entire skeletons or specific limbs. These are available in many sizes; check Web sites that sell anatomical supplies.
- Three-dimensional écorché models. Some of these figures exhibit a high degree of craftsmanship and are beautifully detailed; check medical supply houses or the Internet for information on ordering.

There is, however, no better way for an artist to learn anatomy than by drawing from a live model. Many artists' groups, studios, art schools, universities, community centers, and continuing education programs offer life classes in which any artist may enroll.

Of course, sometimes it's not possible to work from a live model, so many artists work from photographs, building their own reference-image archives with clippings from bodybuilding magazines, photocopied images from art and photography books, and artist's-model images downloaded from the Internet. (Note that you should use such images, which are protected by copyright, for study only and not in work that you intend to show or offer for sale. If you use copyrighted images in your finished work, you risk being sued for copyright infringement.)

Another alternative is to draw from master artists' figurative artwork. By drawing from reproductions in art books or sketching at museums (most of which have liberal sketching policies), you can discover how other artists have interpreted the human figure and how they have solved complex issues regarding anatomical form.

To understand the human figure in continuous movement, try watching DVDs containing sequences of bodies in motion, and use the pause button to freeze the frame so that you can sketch the figure at various moments during a movement.

No matter how you choose to study the human figure, do so at your own pace, acquiring enough anatomical knowledge to serve your artistic needs. You will find that the study of anatomy is an invaluable tool to unlock some of the mysteries of the human body—and that it will give you greater artistic freedom and more creative choices as you pursue your personal art.

STANDING MALE, STRUT POSE

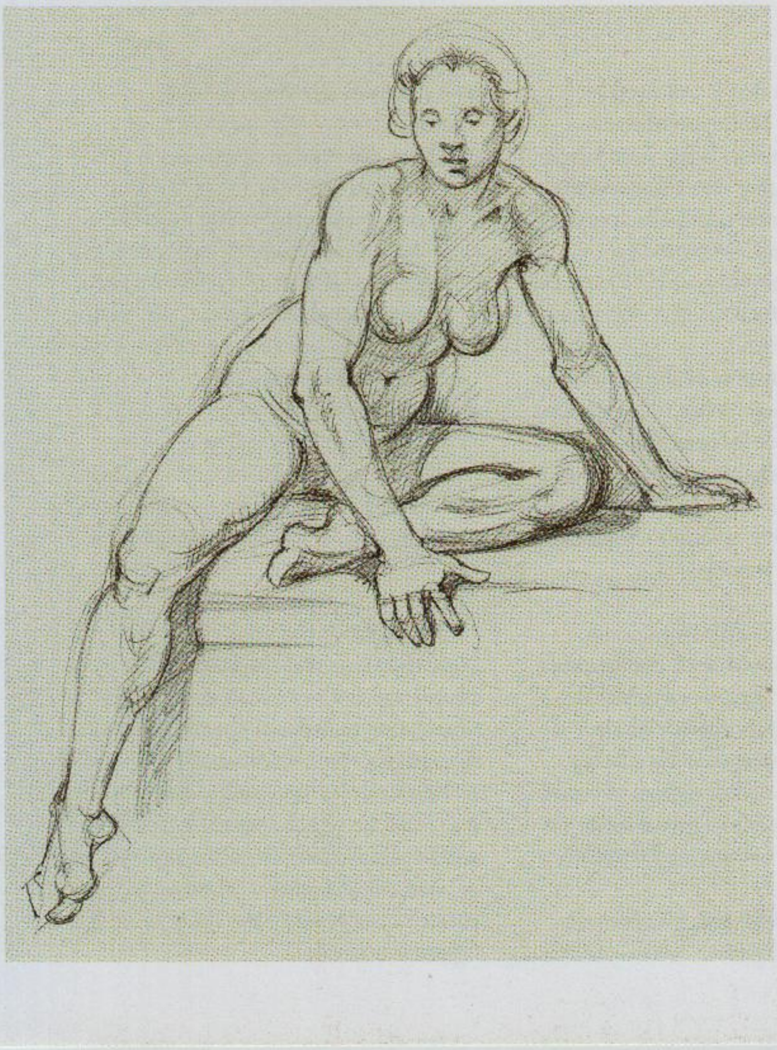
Chapter 1 The Language of Anatomy

Learning the language of anatomy can be challenging, because so many anatomical terms are based on Latin and Greek words and phrases. Some people think that using Latin and Greek is a bit archaic, but the fact is that Latin remains an important scholarly language, and Latin and Greek terminology is still used extensively in the medical field and for various scientific purposes (like the naming of species).

Think of this first chapter as a kind of Rosetta Stone for this book. It will demystify anatomical terms, making them less intimidating and enabling you to decode them.

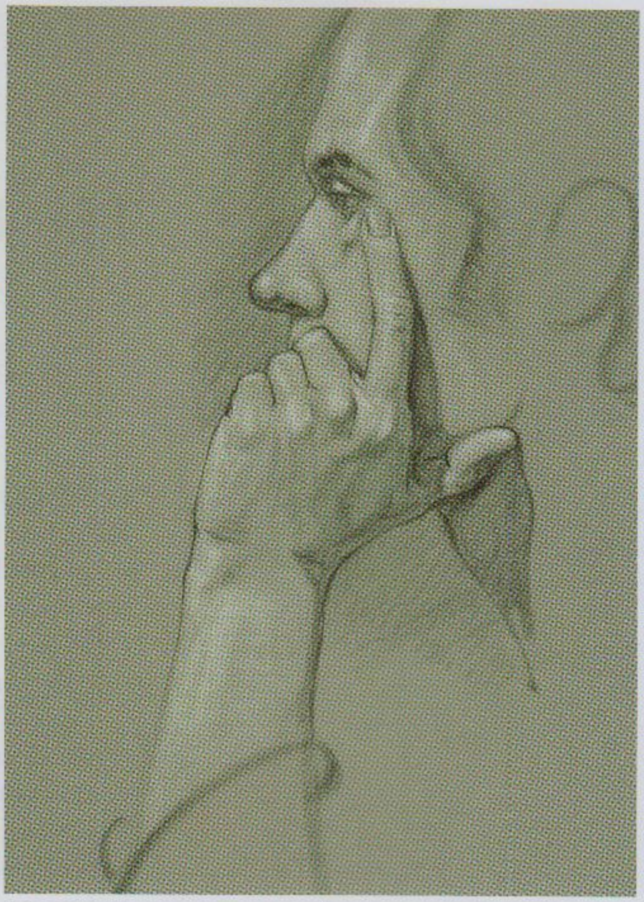
The key to learning any difficult subject is to break it down, bit by bit, in a systematic way. If you are studying artistic anatomy for the first time, start by familiarizing yourself with the basic shapes of the bones and muscles while learning the terms in small increments. As you learn more terms for the skeletal and muscular structures, it will become easier for you to grasp the topography of the human figure.

Proceed at your own pace, learning as much as you feel you need to. Some readers may wish to learn only a few of the basic anatomical terms; others may prefer not to learn any terms at all but instead to focus on the shapes and positions of anatomical forms. In any case, the terms themselves and the explanations I provide are meant to give students of artistic anatomy and instructors who teach artistic anatomy a common language for reference.



Opposite: **ACTION STUDY (BACK VIEW) ON TONED PAPER**

Left: **FEMALE NUDE LEANING FORWARD**



Left: **FEMALE NUDE RESTING** *Right:* **HAND AND HEAD STUDY**

The Structure of This Book

Although there are some minor variations, most of the entries in this book are organized in the following way:

- The name of the anatomical structure.
- A key to the pronunciation of the structure's name in cases where the term has been derived from Latin or Greek or may otherwise be unfamiliar. Sometimes, two or more acceptable pronunciations are given.
- An explanation of the name's origin in cases where it has been derived from Latin and/or Greek roots.
- A list of synonyms frequently used for the same structure. These synonyms are provided because different anatomy texts may refer to the same structure by different names. In some cases, the synonyms lists include older terms that are no longer widely used; some synonyms lists include common names for anatomical structures. All these synonyms will help make you aware of the various terms' histories and will help prevent confusion should you encounter different terms in other sources. Note that most of the synonyms lists include at least one term that is followed by the abbreviation *TA,* in parentheses. This abbreviation stands for *Terminologia Anatomica,* indicating that this particular term is the one internationally accepted by the Federation Committee on Anatomical Terminology (FCAT) and the International Federation of Associations of Anatomists (IFAA).
- A physical description of the structure and its key characteristics. Descriptions of muscles include information on where each muscle attaches to bones or other structures.
- For muscle entries, a section describing the action of the muscle.

Besides these textual components, each entry is illustrated with one or more figures. Each entry includes a detailed drawing on toned paper, with labels, showing the particular structure being discussed. These toned drawings of bones and muscles are meant to give a sense of three-dimensional volume and detail to the form.

In addition, muscle entries generally include two other figures:

- A diagram showing muscle attachments—the locations where the muscle originates and inserts on bones or other structures. Learning the origins and insertions of the muscles (where each muscle begins and where it terminates) can be very valuable to artists, especially to sculptors and to artists who work primarily from memory.
- A diagram illustrating the muscle's action. These movement diagrams include arrows showing the general direction of the action(s) performed by the muscle or group of muscles.

Throughout the book, these basic drawings and diagrams are supplemented by many other figures illustrating matters of special interest to figurative artists. Additionally, the book contains numerous studies drawn from live models, which present a more holistic and organic approach to the interpretation of anatomical forms—whether of particular regions of the body or of the figure as a whole.

Variations in Anatomical Nomenclature

Some anatomical terms have remained unaltered since ancient times, but many have undergone changes—and, in fact, changes in preferred terminology continue to occur. For example, a number of Latin terms have been anglicized in recent decades. In English-language anatomy classes today, teachers usually speak of the *external oblique muscle* rather than using the more formal (and obscure) Latin term *musculus obliquus externus abdominis*. Similarly, they generally prefer the term *spine of the scapula* to the more formal Latin *spina scapulae*.

Although not used in scientific work, many colloquial terms are commonly used by teachers and students of artistic anatomy. These include terms such as *collarbone* (rather than the formal *clavicle*), *shoulder blade* (rather than *scapula*), and *backbone* (rather than *vertebral column*). These colloquial terms (and many others) are given in the synonyms lists that accompany the entries.

Eponymic terms for anatomical structures—terms that contain the names of people—are falling out of favor, for good reason. Such terms—for example, *Achilles tendon, Adam's apple,* and *angle of Louis*—do not properly describe the structures they refer to or give you any idea where the structures are located. They are therefore being replaced with more accurate terminology, such as *calcaneal tendon* (or, in Latin, *tendo calcaneus*) for the Achilles tendon, *laryngeal prominence (prominentia laryngea)* for the Adam's apple, and *sternal angle (angulus sterni)* for the angle of Louis.

The Meanings of Anatomical Terms

Once you understand the basic meanings of anatomical terms—or, rather, the Latin and Greek roots from which they derive—it becomes relatively easy to locate the structures they refer to. For instance, the brachialis muscle of the upper arm gets its name from the Latin word meaning "pertaining to the arm."

Knowing the Latin and Greek terms can also help you grasp the size, shape, and function of various anatomical structures. These meanings are covered extensively throughout the book, but here are just a few examples:

- The term *coccyx* (for the tailbone) comes from the Greek word for cuckoo. This makes sense when you realize that the coccyx resembles a bird's beak.
- The deltoid muscle of the shoulder gets its name from the Greek letter delta. Delta (in Greek, Δ) has a triangular shape, as does the deltoid muscle.
- Simply knowing that *major* means "greater" (or "larger") and *minor* means "lesser" (or "smaller") allows you to grasp the relative sizes of structures whose names incorporate these terms. For example, the teres major is the larger round muscle of the scapula, as distinct from the teres minor, which is the smaller round muscle of the scapula.

Likewise, learning directional terms can help you navigate around the human figure. If you know that the term *lateral* refers to things on the outer sides of the body and its parts and that *medial* refers to things on the inner sides, you will easily grasp the different locations of the vastus lateralis (the very large muscle on the outside of the thigh) and the vastus medialis (the very large muscle on the inside of the thigh).

Basic movement terms are essential to an understanding the types and directions of motion of various body parts. These terms include *flexion* (bending), *extension* (straightening), *abduction* (moving away from), and *adduction* (moving back toward), as well as *rotation* (the pivoting of a body part, as when the torso twists) and *circumduction* (the circular movement of a body part, such as an arm).

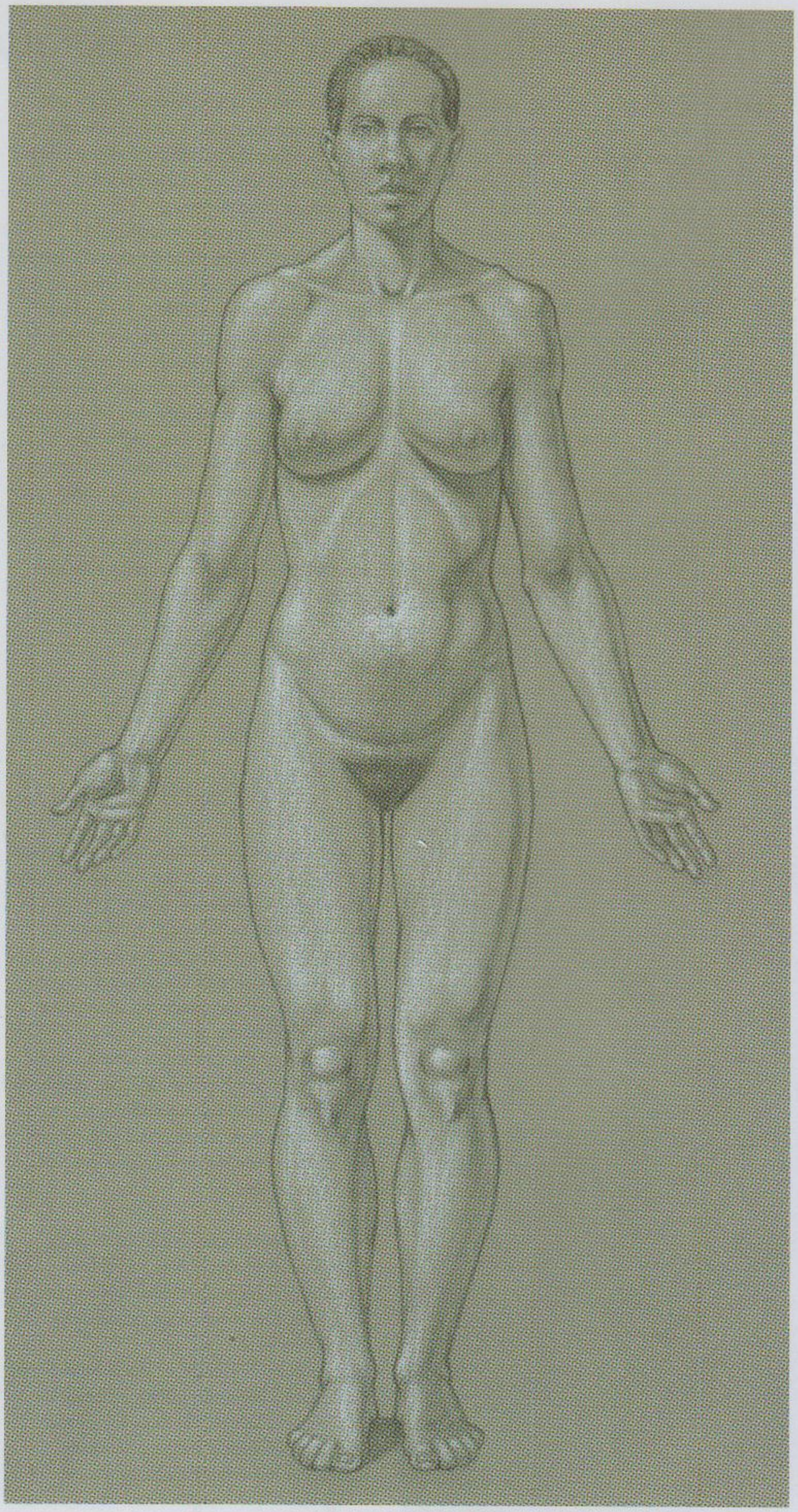
STUDY OF TIMOTHY

The Anatomical Position

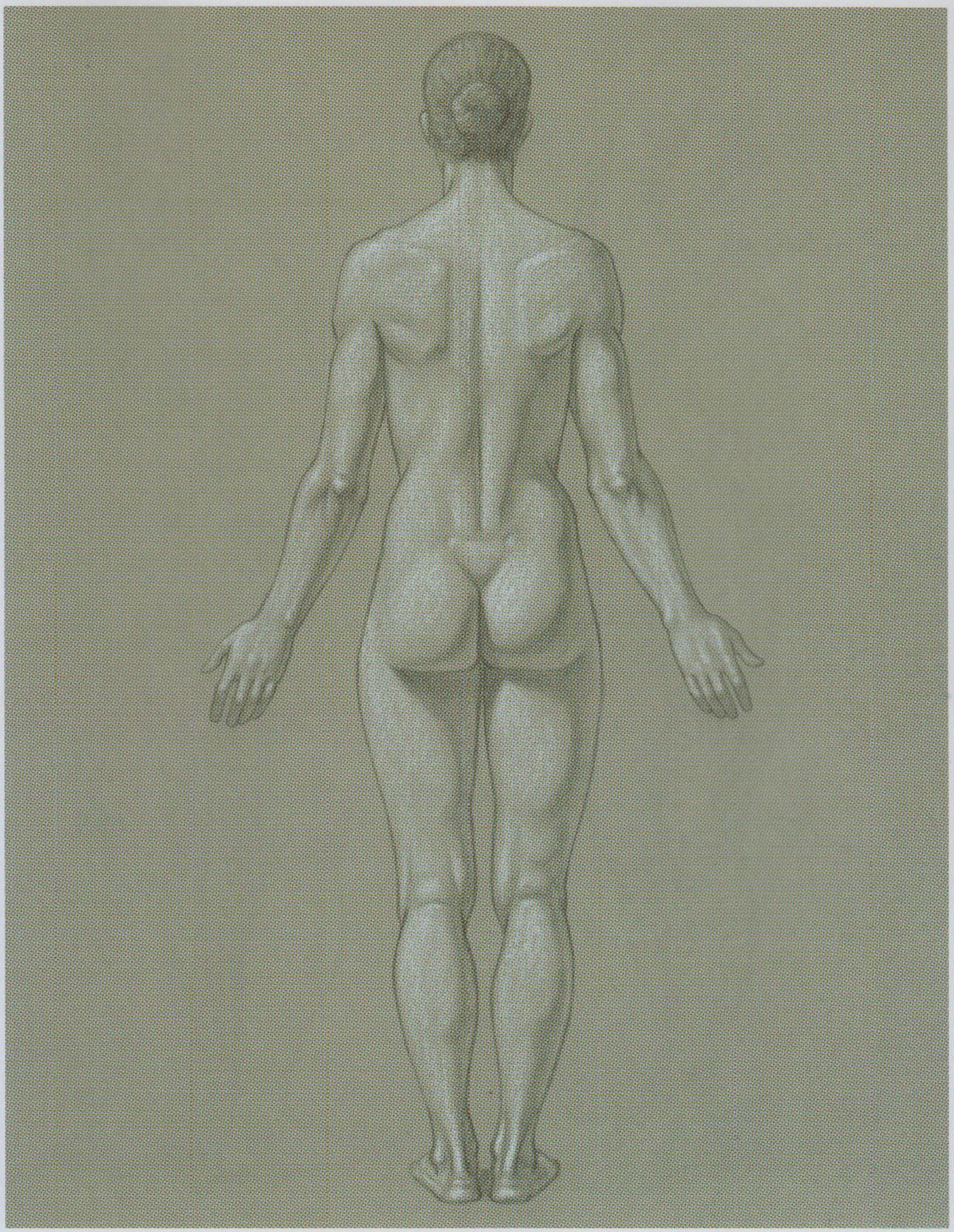
The anatomical position is the standard international reference position used to identify the various sections and structures of the human body. The anatomical position provides an agreed-upon reference to avoid confusion regarding anatomical terms. Most directional terms, the terms for anatomical movements, and the names of some bones and muscles refer to the body in this position.

Here are the basic attributes of the anatomical position, which is used in many diagrams throughout this book:

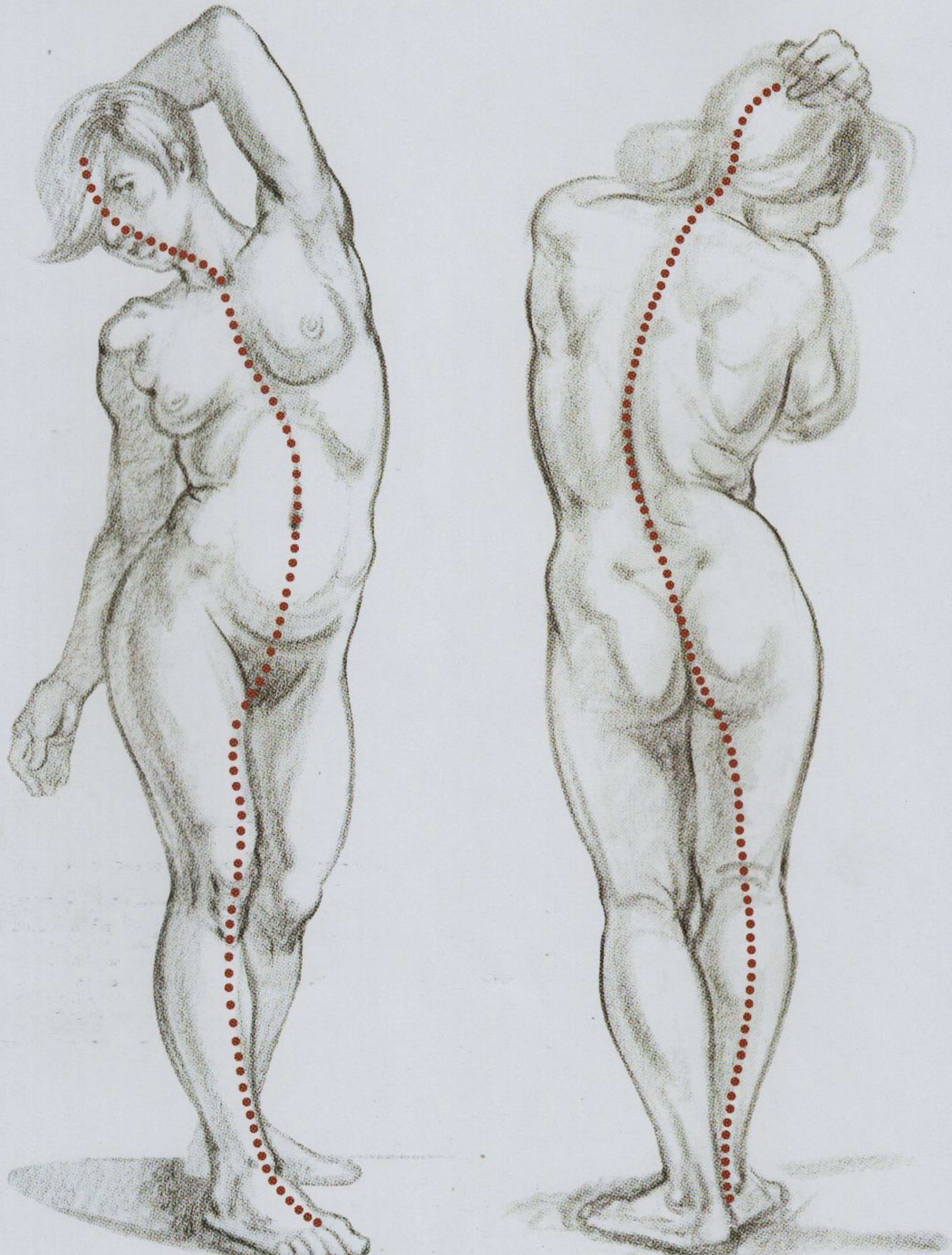
- The body is shown in an erect, standing posture with the weight evenly distributed.
- The arms are positioned at the sides, slightly away from the body. The palms face forward and the thumbs point away from the body, putting the bones and muscles of the lower arms in straight alignment. This makes it easier to see the entire anterior (front) aspect of the arms in front views and the entire posterior (back) aspect of the arms in back views.
- The feet face forward and are flat on the floor, either together or slightly apart.
- The head faces forward.



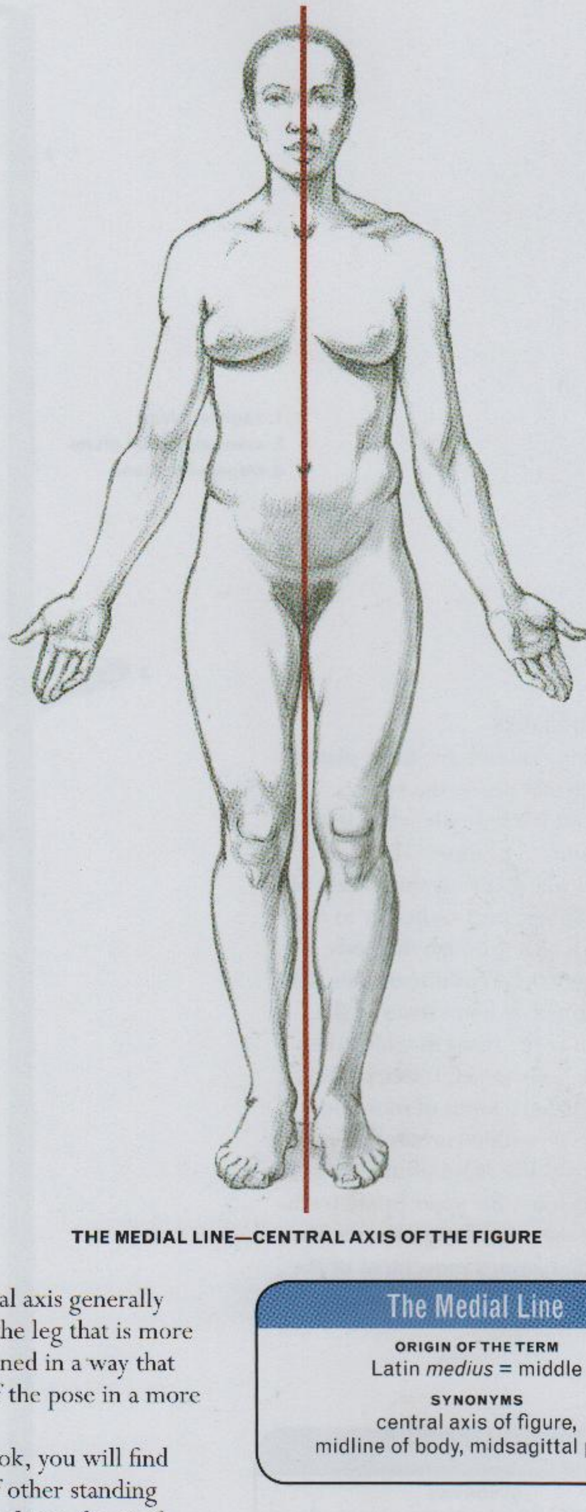
THE ANATOMICAL POSITION
Anterior view



THE ANATOMICAL POSITION
Posterior view



THE MEDIAL LINE—CONTRAPPOSTO POSITIONS



THE MEDIAL LINE—CENTRAL AXIS OF THE FIGURE

The Medial Line

The medial line is the central axis of the figure, dividing the body vertically into equal right and left halves. (In medical terminology, it is referred to as the *midsagittal plane.*) On the front (anterior) side of the body, the medial line travels straight down through the cranium, breastbone, navel, and pubic bone, continuing between the legs down to the ground. On the back (posterior) side, the medial line goes through the cranium, follows the spine, and again continues down to the ground between the legs.

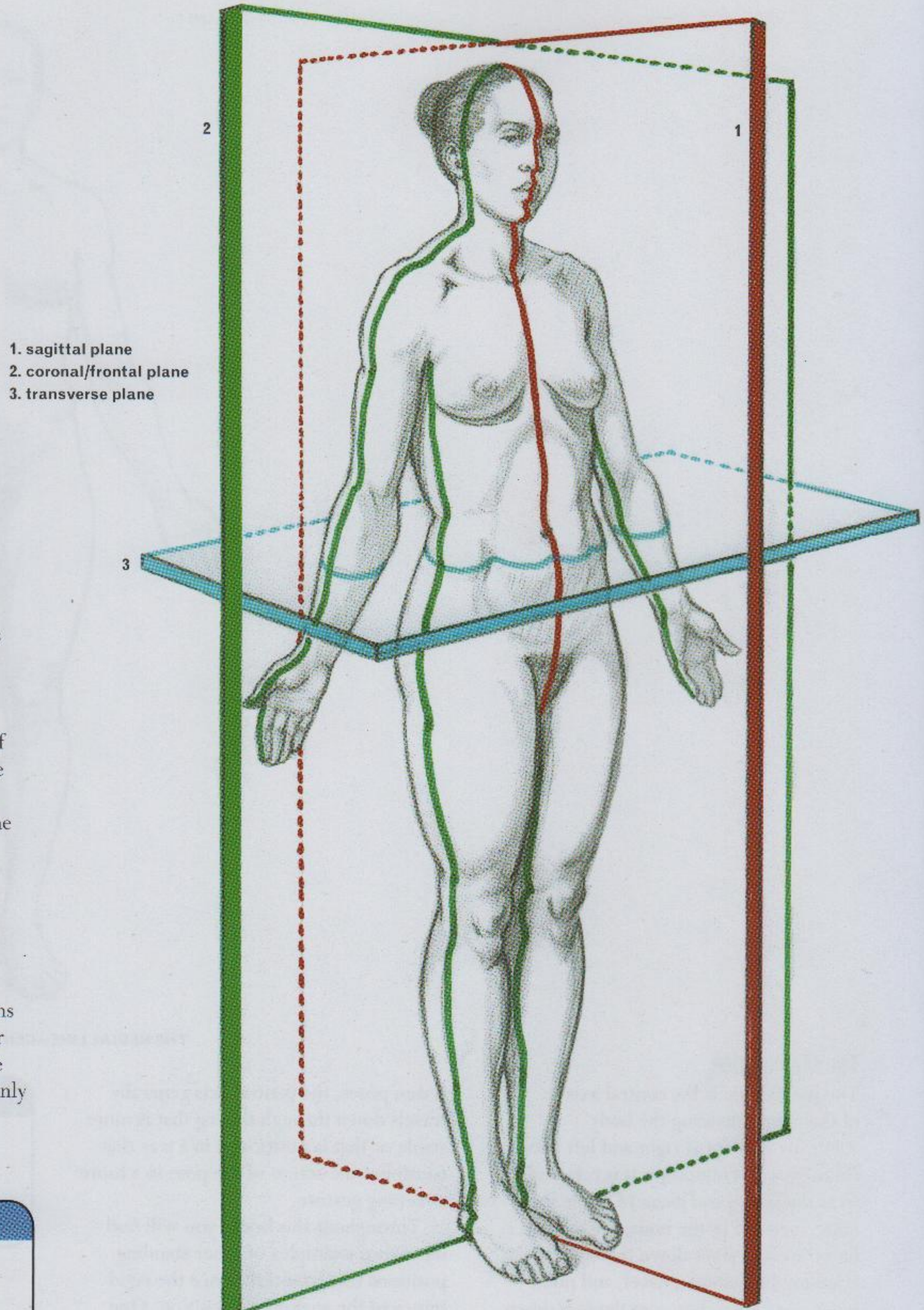
The central axis of the body is a valuable landmark because it helps you accurately assess the figure's position, as when there is a noticeable tilt to the torso or a twisting action in the torso. In action poses, the central axis generally travels down through the leg that is more stable or that is positioned in a way that continues the action of the pose in a more sweeping gesture.

Throughout this book, you will find numerous examples of other standing positions that counterbalance the rigid stance of the anatomical position. One type of standing position that is often seen, especially in classical and classically influenced art, is the contrapposto position, an elegant pose in which most of the figure's weight is placed on one leg and the knee of the other leg is slightly bent. There are numerous variations on the contrapposto pose, which differ according to the placement of the arms and the position of the feet.

The Medial Line

ORIGIN OF THE TERM
Latin *medius* = middle

SYNONYMS
central axis of figure, midline of body, midsagittal plane



THE ANATOMICAL PLANES

Anatomical Planes

The anatomical planes are three planes of reference that divide the body vertically and horizontally while it is in the anatomical position. Think of these imaginary planes as thin sheets of transparent glass, perpendicular to one another, that slice through the body, creating three different dimensions. The outside borders or boundaries of the planes include the space in which the parts of the body (head, torso, limbs) can move. Specific kinds of movement can only occur within certain planes. Being aware of the anatomical planes helps artists learn the appropriate terms for various anatomical movements. For instance, the forward movement of the flexion (bending) of the spine occurs only in the sagittal plane.

Anatomical Planes

SYNONYMS
plana (TA), body planes, planes of reference, planes of movement, cardinal planes, planes of section, principal planes

Sagittal Plane

PRONOUNCIATION
SAAJ-ih-tul

ORIGIN OF THE TERM
Latin *sagitta* = arrow

SYNONYMS
plana sagittalia (TA), plana medianum (TA), median plane, midsagittal plane, medián-sagittal plane

Coronal Plane

PRONOUNCIATION
KOR-uh-nul

ORIGIN OF THE TERM
Latin *corona* = crown, garland

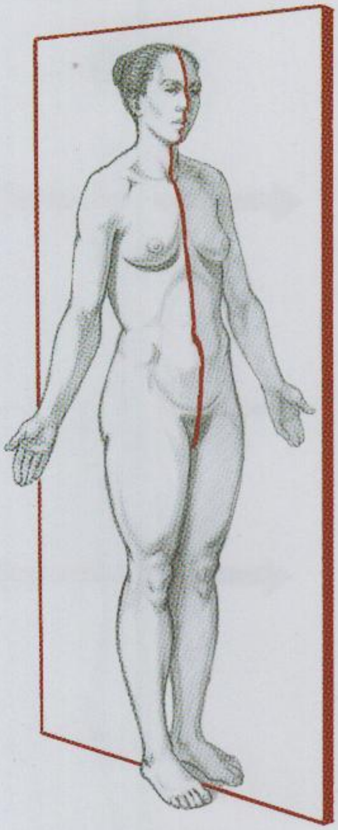
SYNONYMS
plana frontalia (TA), plana coronalia (TA), frontal plane, anterior plane

Transverse Plane

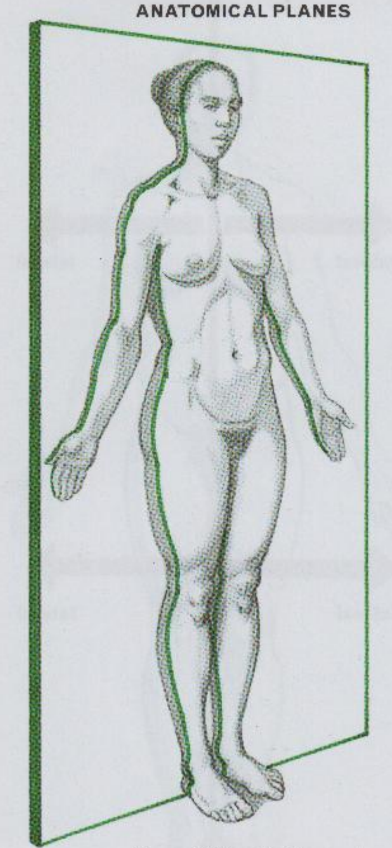
ORIGIN OF THE TERM
Latin *transversus* = crosswise, turned across

SYNONYMS
plana transversalia (TA), horizontal plane, axial plane, transaxial plane, cross-sectional plane, cross, cross section

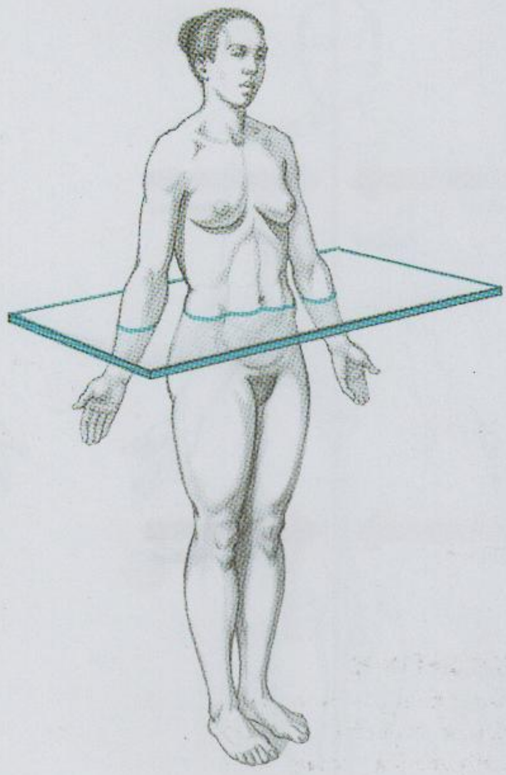
ANATOMICAL PLANES



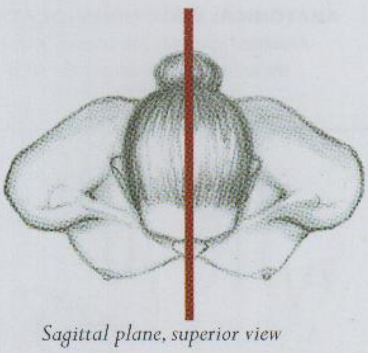
Sagittal plane



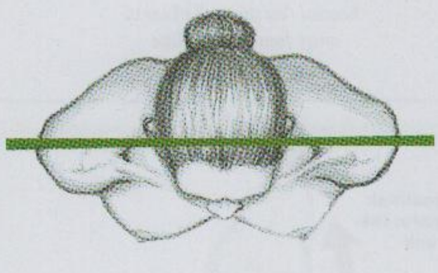
Coronal/frontal plane



Transverse plane
A transverse plane can divide the figure horizontally at any point; in this example, it is placed below the waist.



Sagittal plane, superior view



Coronal/frontal plane, superior view

Transverse plane, superior view
In this example, the transverse plane is positioned below the shoulders.

Sagittal Plane

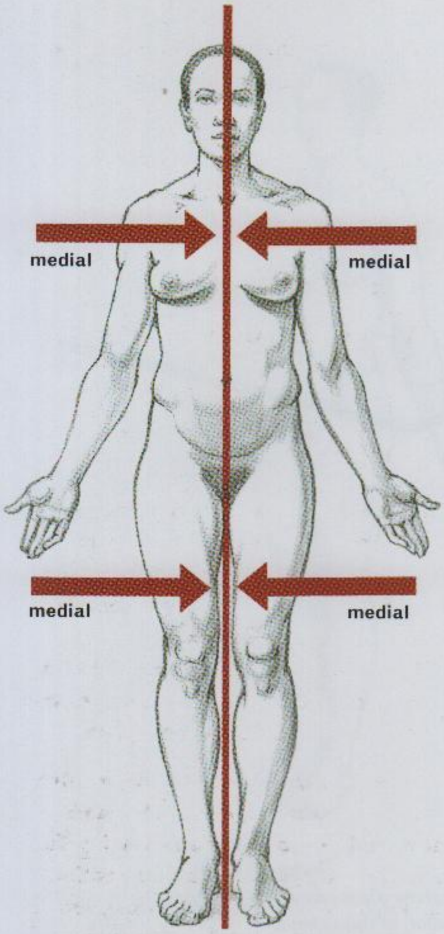
The sagittal plane divides the body vertically into equal right and left halves. This plane is also referred to as the *midsagittal plane* because it is on the midline of the body. Any vertical division that runs near the sagittal plane and parallel to it—and that divides the body into *unequal* right and left portions—is referred to as a parasagittal plane, or paramedian plane (not illustrated). Movements within the sagittal plane are flexion and extension—forward and backward movements of the head, spine, and limbs.

Coronal Plane

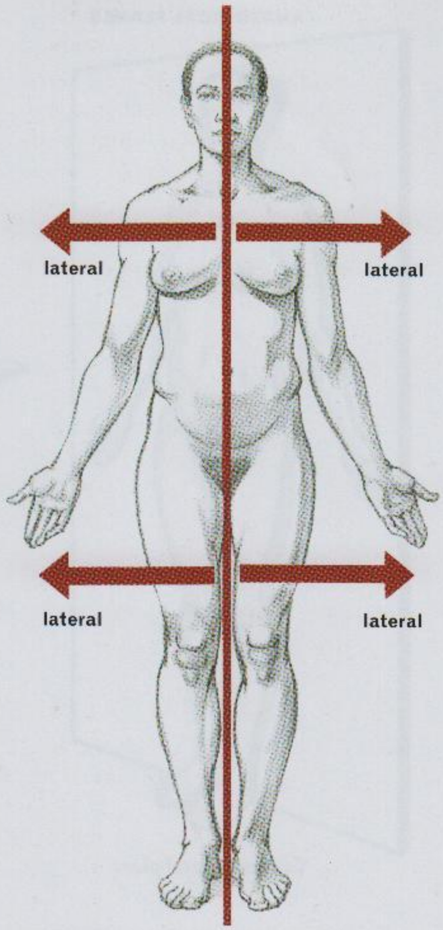
The coronal plane divides the body vertically into equal front (anterior) and back (posterior) portions. The coronal plane, (also referred to as the frontal plane) is always perpendicular to the sagittal plane. Movements within this plane are abduction and adduction (side-to-side movements of the arms and legs) and lateral flexion (side-to-side movements of the head, neck, and torso).

Transverse Plane

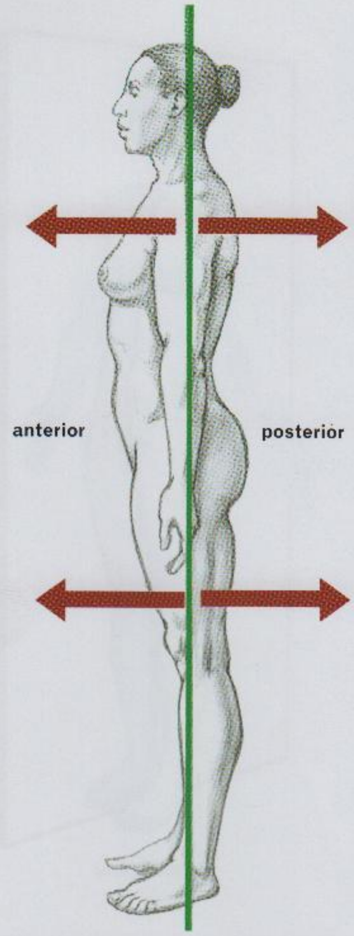
A transverse plane divides the body horizontally, from side to side or left to right, into upper (superior) and lower (inferior) portions. Traditionally, when the transverse plane is indicated in anatomical charts, its division is placed below the waist. However, transverse planes can cut horizontally across the body at any point. Moreover, any section of the body or body part may be divided by a transverse plane. For example, the torso may be divided horizontally into upper and lower sections, as may a bone (like the scapula, or shoulder blade). Movements within transverse planes include rotation of the head, spine, and limbs.



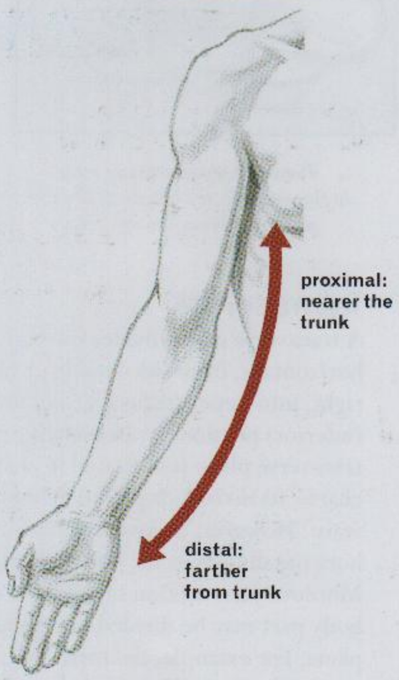
ANATOMICAL DIRECTIONS/LOCATIONS
Medial (on sagittal plane): toward medial line



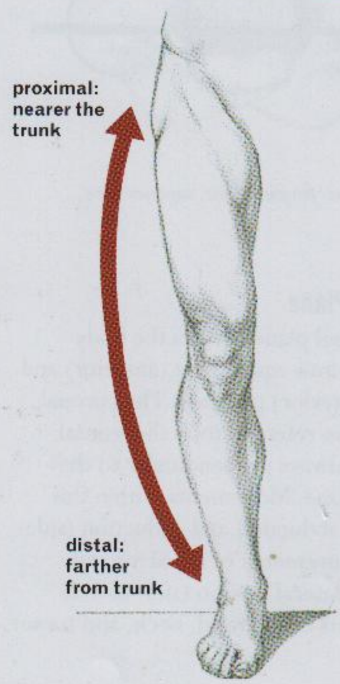
ANATOMICAL DIRECTIONS/LOCATIONS
Lateral (on sagittal plane): away from medial line



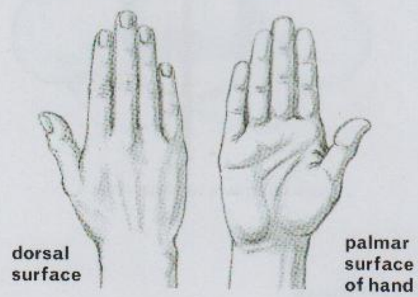
ANATOMICAL DIRECTIONS/LOCATIONS
Anterior/posterior (on coronal plane): toward the front/toward the back



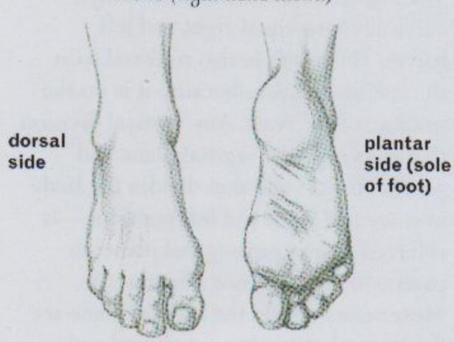
Upper and lower arm



Upper and lower leg

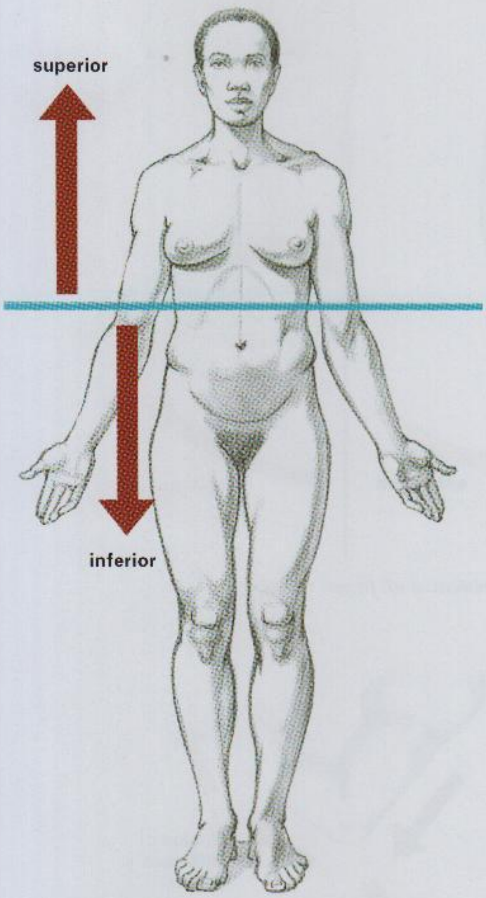


Hand (right hand shown)



Foot (right foot shown)

OTHER ANATOMICAL DIRECTION/LOCATION TERMS
Pertaining to limbs only



ANATOMICAL DIRECTIONS/LOCATIONS
Superior / inferior (on transverse plane): above / below

Anatomical Directions/Locations

Anatomical directions—also commonly called anatomical locations—describe the locations of the various bones and muscles in relation to one another when the figure is standing in the anatomical position. Once the anatomical planes have been established, the anatomical locations map the placement of specific structures. For the most part, these terms are grouped in pairs of opposites. For example, the medial (inside) border of the scapula (shoulder blade) is closer to the medial line of the body, whereas the lateral (outside) border of the scapula is on the outer side, farther away from the medial line. For easy reference, the terms for the anatomical directions/ locations and their meanings are given in the table below.

Terms for Anatomical Movements

When you study anatomy, it is also essential for you to become familiar with the terms describing various movements. Learning the anatomical movement terms can help you to recognize the particular kind of movement occurring within a pose as well as to identify the joints and muscles involved.

Differences in movements result from several factors, in combination:

- The type of joint involved
- The shapes of the participating bones
- The type(s) of muscle(s) acting on a particular joint
- The muscle or muscles' origin and insertion attachments

Anatomical movements occur within one anatomical plane or all three anatomical planes. The kinds of movements that can be performed differ from plane to plane:

- *Flexion* and *extension* are movements occurring within the sagittal plane.
- *Abduction, adduction,* and *lateral flexion* are movements occurring within the coronal plane.
- *Rotation, lateral rotation, medial rotation, protraction,* and *retraction* are movements occurring on the transverse plane.

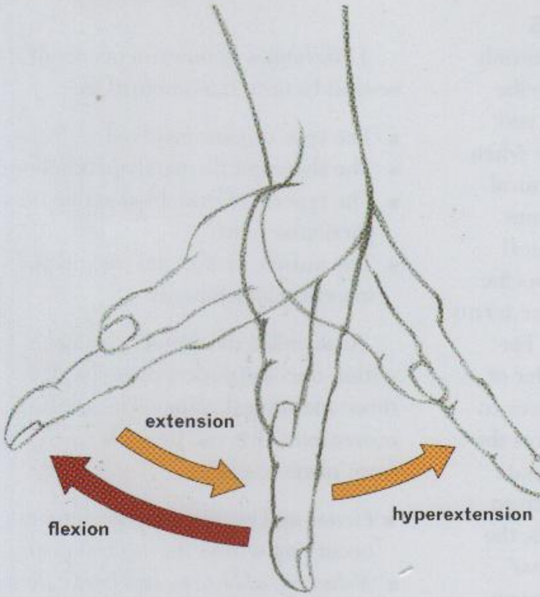
Some anatomical movements involve all three anatomical planes. One such movement is *circumduction*: swinging the arm (for example) in a circular motion encompasses the sagittal, coronal, and transverse planes at different points during the movement.

Anatomical Directions/Locations

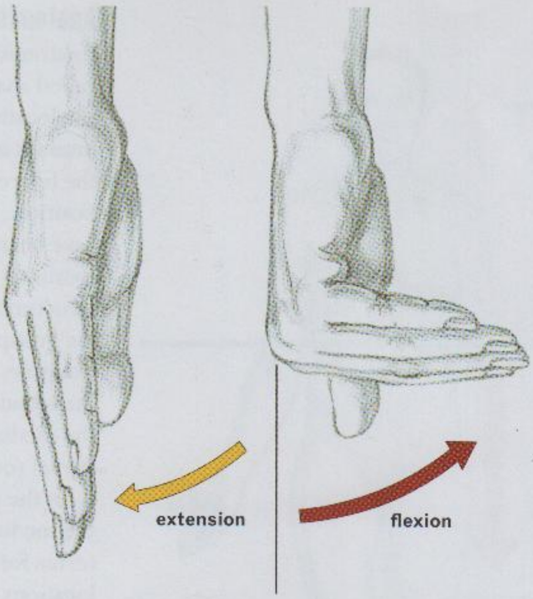
SYNONYMS
directional terms, terms of direction, terms of location, locations, terms of position, terms of relation

Anatomical Directions/Locations

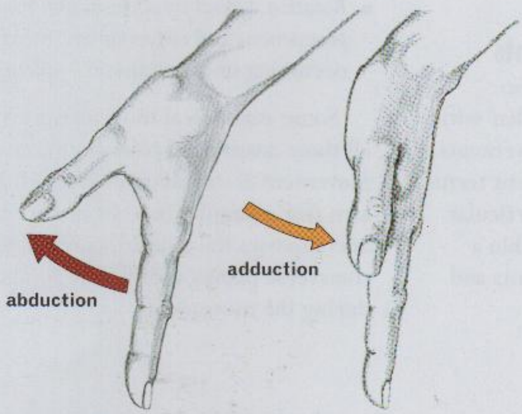
TERM	MEANING
Medial	*Toward* the medial line or central axis of the body.
Lateral	*Away from* the medial line or central axis of the body
Anterior	*In front of*; toward the front of the body; ventral
Posterior	*In back of*; toward the back of the body; dorsal
Superior	*Above*; refers to structures closer to the head or toward the upper part of a structure or body part
Inferior	*Below*; refers to structures closer to the feet or toward the lower part of a structure or body part
Direction/Location Terms Pertaining to the Limbs	
Proximal (PROK-sih-mull)	*In close proximity to*; nearer the center of the body or the point of origin of the limb on torso (can pertain to limbs, fingers, and toes)
Distal (DISS-tull)	*Distant from*; farther from the center of the body or the point of origin of the limb on the torso (can pertain to limbs, fingers, and toes)
Dorsal Side of Hand (DOOR-sull)	The back of the hand; also called the dorsum (DOOR-sum)
Palmar Side of Hand (PAHL-mar *or* PAWL-mer)	The palm of the hand
Dorsal Side of Foot	The upper side of the foot; also called the dorsum (DOOR-sum)
Plantar Side of Foot (PLAN-tar)	The underside, or sole, of the foot
Volar (VOH-lar)	Refers to either the palm of the hand or the sole of the foot



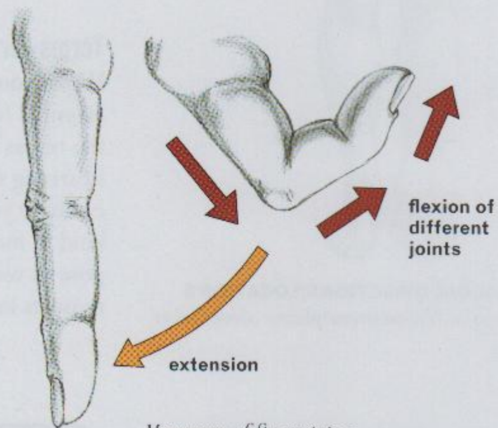
Movement of wrist joint



Movement of all fingers together



Movement of thumb joint on sagittal plane



Movement of finger joints

FLEXION AND EXTENSION

Movement on sagittal plane

Movement Within the Sagittal Plane

The movements that occur within the sagittal plane are angular movements, primarily *flexion* and *extension*. Flexion (bending) usually takes place in the anterior direction, forward from the anatomical position. The exception is the flexion of the knee, in which the lower leg moves only in the posterior direction, backward from the anatomical position. Extension (straightening) is the reverse of flexion, returning the body part back to the anatomical position.

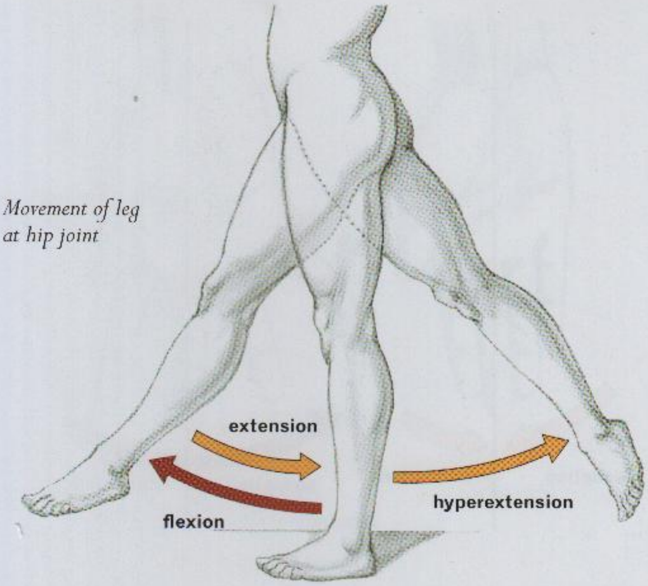
Leaning in a posterior, or backward, direction is also sometimes referred to as extension, but some experts call it *hyperextension* because the movement goes beyond the normal limit. (As you can see from the drawing at lower right, opposite, the term *hyperextension* is applied both to the backward leaning of the whole upper body and to a backward movement of the head.)

Movements Within the Sagittal Plane

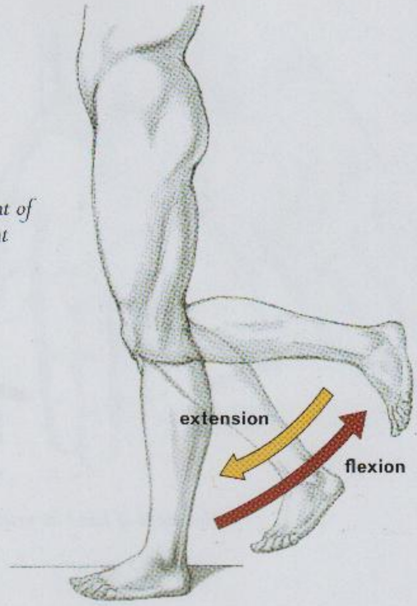
MOVEMENT	MEANING	ORIGIN OF TERM
Flexion	The action of *bending*, which decreases the angle between two bones or two parts of the body.	Latin *flectere* = to bend
Extension	The action of *straightening*, which increases the angle between two bones or two parts of the body. The opposite of flexion, extension returns the joint or body part to the anatomical position.	Latin *extendere* = to stretch out
Hyperextension	Extension of a limb or body part *beyond the anatomical position* (or normal limit).	Greek *hyper* = above, over + Latin *extendere* = to stretch out

THUMB MOVEMENT WITHIN THE SAGITTAL PLANE

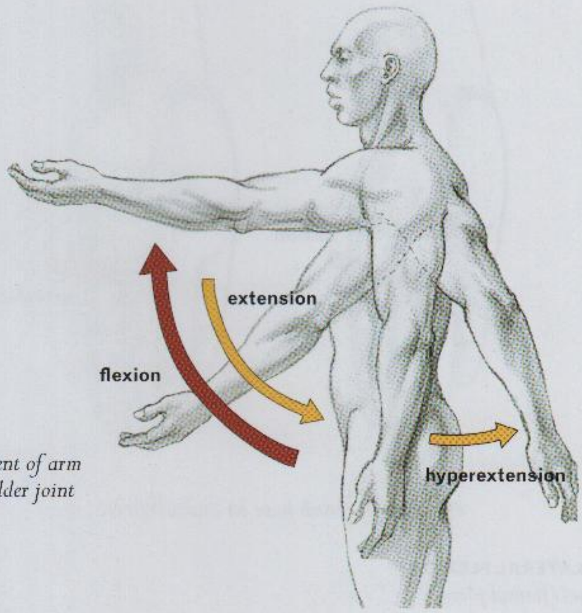
The movement of the thumb forward and backward within the sagittal plane is not flexion and extension but rather abduction and adduction. The side-to-side movements of the thumb within the coronal plane are described as flexion and extension. This is not as confusing as it might seem: Because the thumb is positioned sideways on the hand (rotated approximately 90 degrees from the other digits), it faces in a different direction from the other fingers—that is, laterally (toward the outside of the body) rather than in the posterior direction (toward the back) when the hand is in the anatomical position.



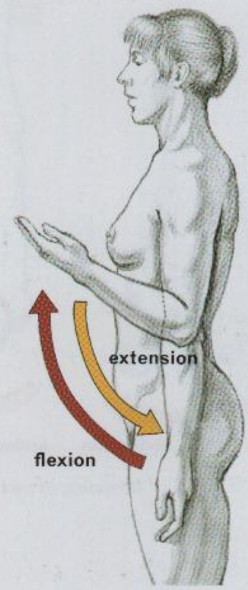
Movement of leg at hip joint



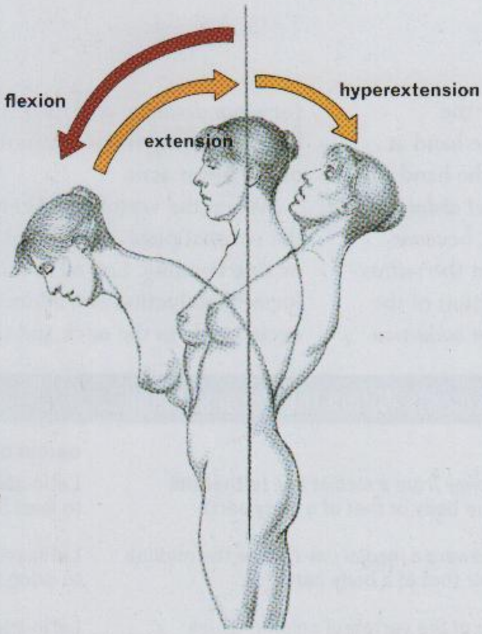
Movement of knee joint



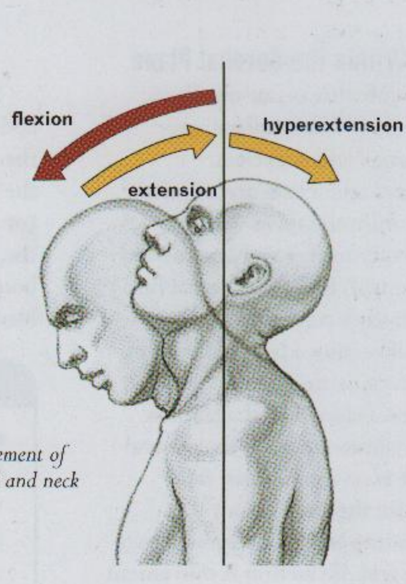
Movement of arm at shoulder joint



Movement of elbow joint

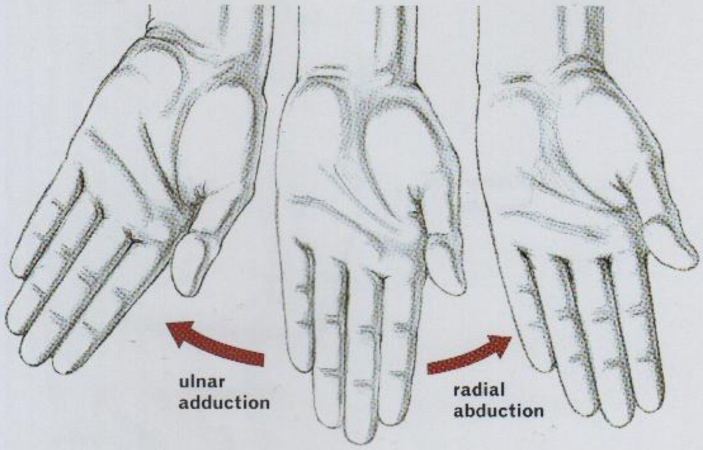


Movement of vertebral column

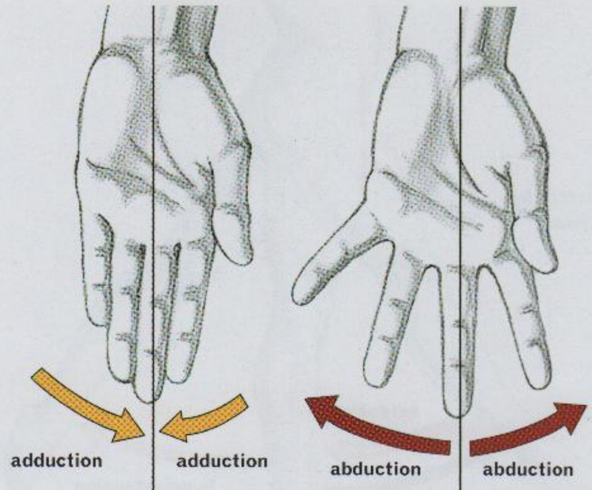


Movement of head and neck

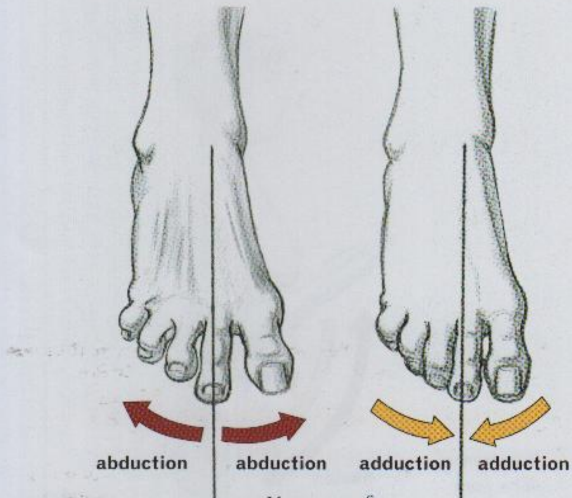
FLEXION AND EXTENSION
Angular movements on sagittal plane



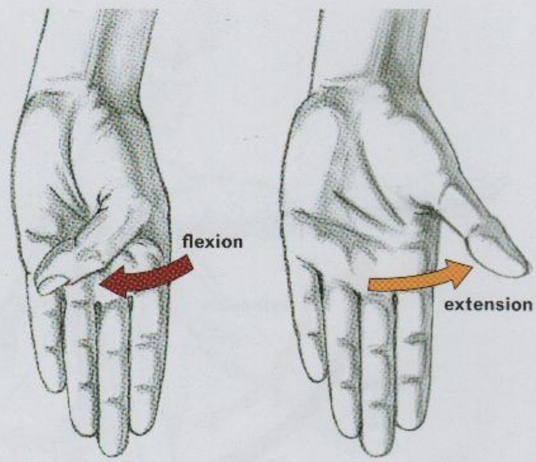
Movement of hand at wrist joint



Movement of fingers



Movement of toes



Movement of thumb joint on coronal/frontal plane

ABDUCTION/ADDUCTION AND LATERAL FLEXION
Angular movements on the coronal/frontal plane

Movement Within the Coronal Plane

The movements that occur on the coronal plane, or frontal plane, are mainly *abduction* and *adduction*. Abduction and adduction are angular, side-to-side movements in which a part of the body moves away or toward a medial (central) line. The medial line may be the body's central axis or a central line bisecting a particular form, such as the foot or the hand.

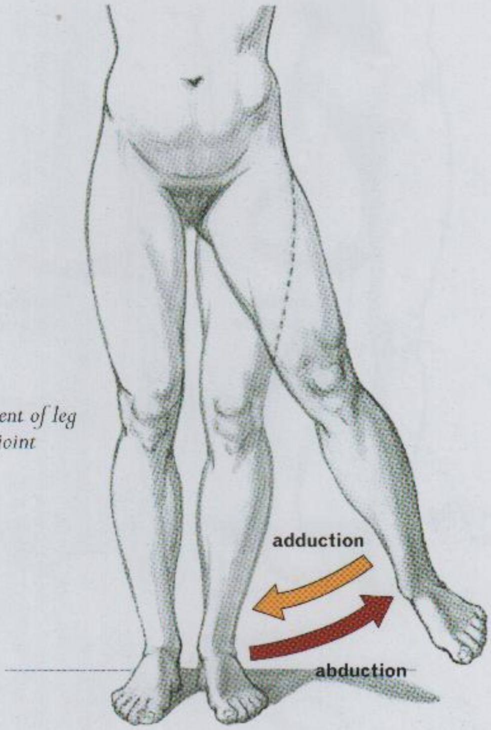
The terms *abduction* and *adduction* are easy to confuse because they sound so similar. It is recommended that you memorize the distinction: *AB*duction is movement *away from* the medial line, and *AD*duction is movement *toward* the medial line.

There are special terms for the abduction and adduction of the hand at the wrist joint. Abduction of the hand at the wrist is referred to as *radial abduction* (or *radial deviation of the wrist*), because the hand is leaning sideways on the radius bone of the lower arm. Adduction of the hand at the wrist is called *ulnar adduction* (or *ulnar deviation of the wrist*), because the hand is leaning sideways on the ulna bone of the lower arm.

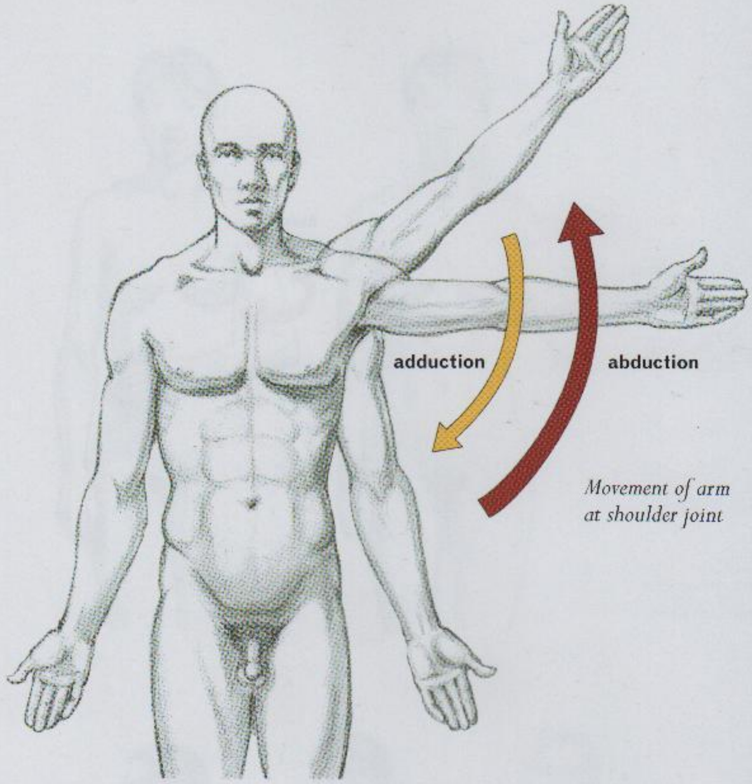
When the vertebral column moves in the coronal plane, it is called *lateral flexion*, or side bending. Lateral flexion is a special form of abduction and adduction that occurs only in the neck and torso.

Movements Within the Coronal Plane

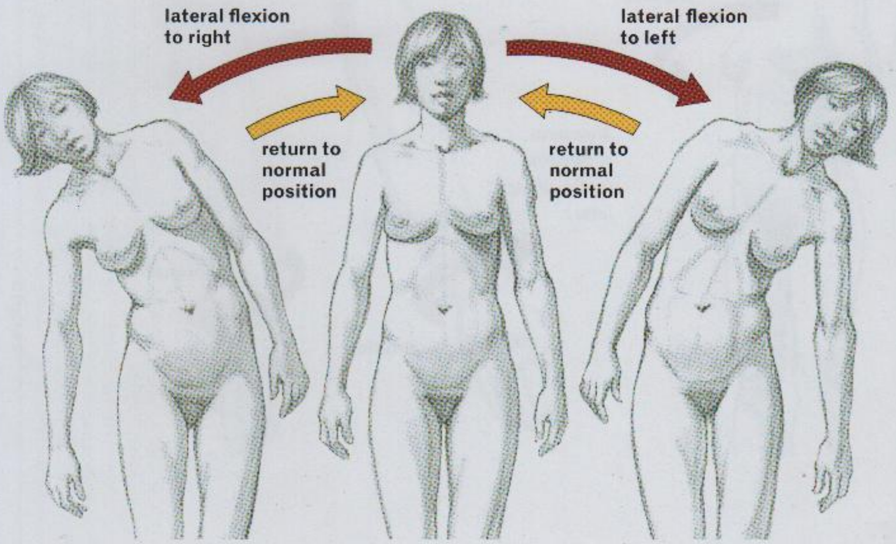
MOVEMENT	MEANING	ORIGIN OF TERM
Abduction	Movement *away from a medial line* (either the midline of the body or that of a body part)	Latin *abducere* = to lead or take away
Adduction	Movement *toward a medial line* (either the midline of the body or that of a body part)	Latin *addere* = to bring forward
Lateral Flexion	*Side bending* of the vertebral column (trunk and/or head)	Latin *lateralis* = side + *flectere* = to bend



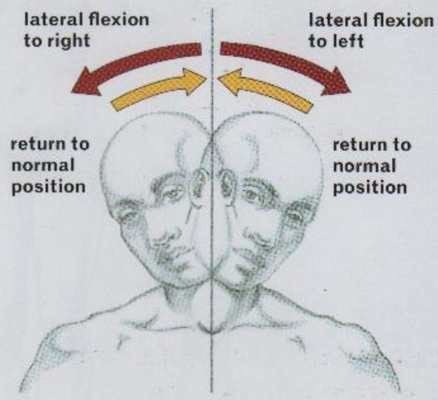
Movement of leg at hip joint



Movement of arm at shoulder joint



Movement of torso (vertebral column)



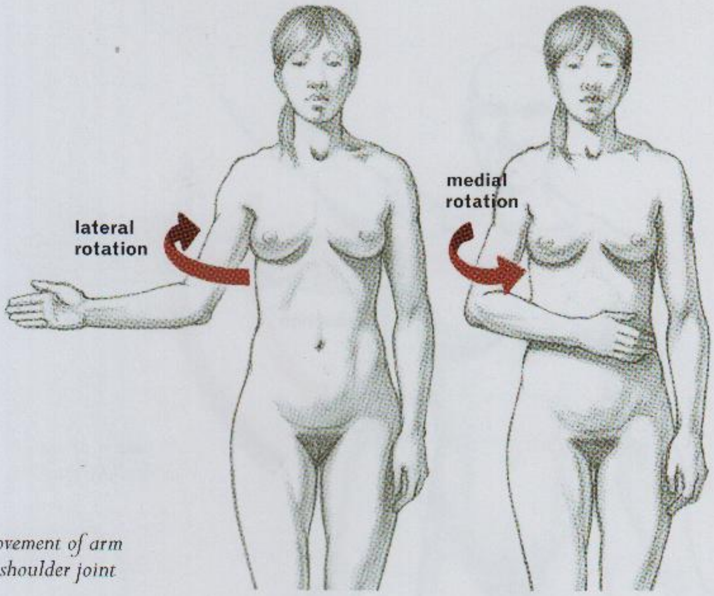
Movement of head and neck (cervical vertebrae)

ABDUCTION/ADDUCTION AND LATERAL FLEXION
Angular movements on the coronal/frontal plane

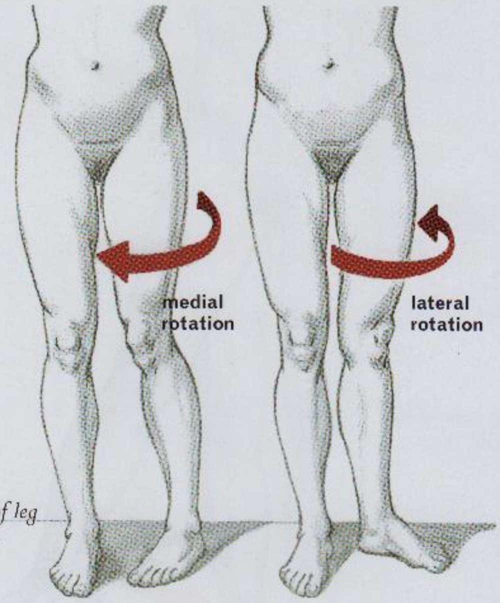
FINGER AND TOE MOVEMENT WITHIN THE CORONAL PLANE

Abduction of the fingers and toes means spreading them apart from one another. The central axis (medial line) of the hand occurs in the third (middle) finger, so when the fingers are abducted, they move away from the neutrally positioned middle finger. The fifth and fourth fingers move away in one direction, and the second (index) finger moves away in the other direction. (As explained earlier, thumb movements within the coronal plane are flexion and extension, because the thumb is rotated approximately 90 degrees from the fingers.)

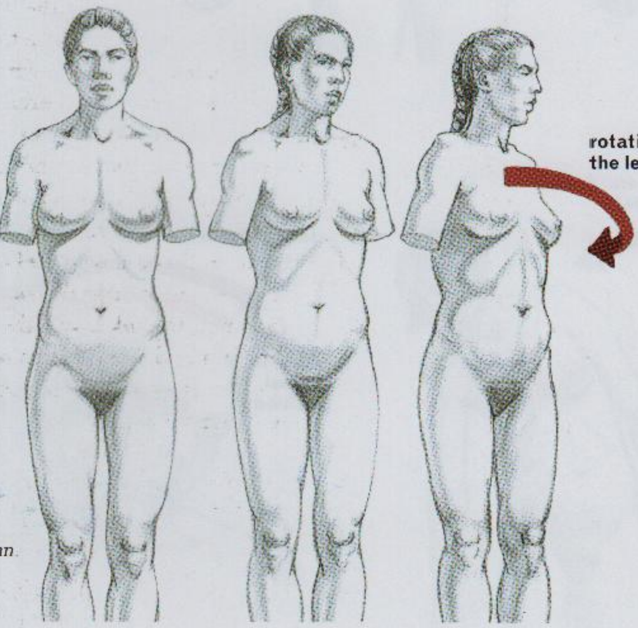
The central axis of the foot is through the second toe. The great toe (big toe) abducts away from the second toe in one direction, and the fifth, fourth, and third toes abduct in the opposite direction. Adduction of the fingers or toes means returning them to their normal position.



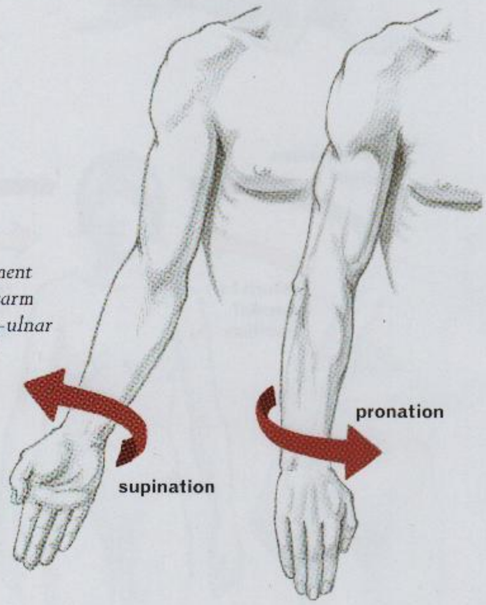
Movement of arm at shoulder joint



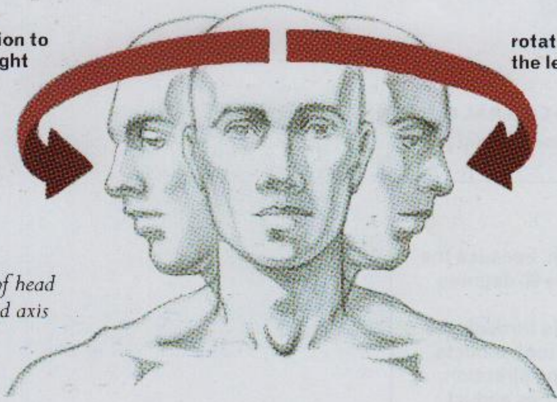
Movement of leg at hip joint



Movement of vertebral column



Movement of forearm (radio-ulnar joint)

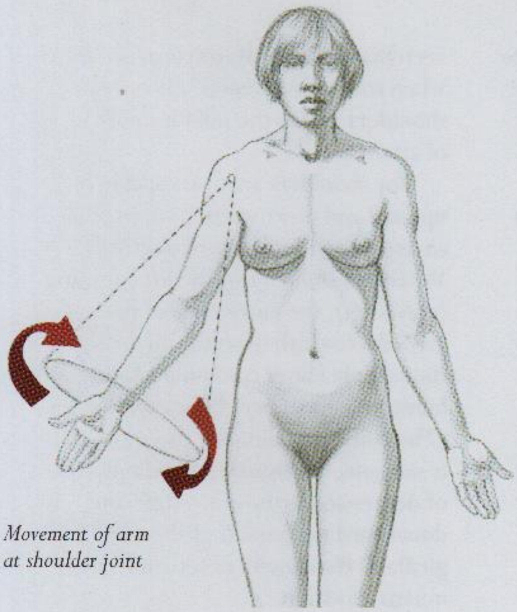


Movement of head (at atlas and axis vertebrae)

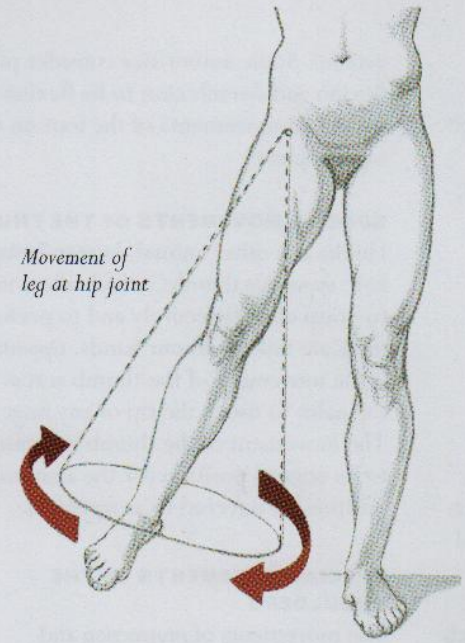
ROTATIONAL MOVEMENTS
Movement on transverse planes

ROTATIONAL MOVEMENTS OF THE FOREARM

Supination and *pronation* are specialized rotational movements of the forearm that occur near the elbow (a pivot joint) and differ from rotational movements at ball-and-socket joints (such as the rotation of the humerus at the shoulder joint). In pronation, the radius bone pivots and crosses over the more stationary ulna bone where the two bones form an X. The movement of supination occurs when the radius pivots back to its normal position.



Movement of arm at shoulder joint



Movement of leg at hip joint

CIRCUMDUCTION
Movement on all planes

Movement Within Transverse Planes

The movements that occur within a transverse plane are generally rotational movements. While the body is in the anatomical position, the movement of rotation will be horizontal (parallel to the ground) and will rotate (pivot) either toward or away from the central axis of the figure (medial line). Rotation involves the turning of a bone around its own long axis, as with the upper arm bone (humerus) at the shoulder joint or the upper leg bone (femur) at the hip joint.

Rotation can be either lateral or medial. In the *lateral rotation* of the limbs, the anterior (front) surface of the humerus or femur turns laterally—toward the outside, or away from the medial line of the body. In the *medial rotation* of the limbs, the anterior surface of the humerus or femur turns medially—inward, or toward the medial line of the body.

The vertebral column is also capable of rotation. When the torso twists either left or right, the vertebral column pivots on its own long axis. The rotation of the head occurs between the first two vertebrae of the neck (the cervical vertebrae referred to as the atlas, or C-1, and the axis, or C-2). This pivoting action turns the head side to side, as when someone shakes his or her head "no."

Movement Within All Three Planes

Circumduction is a movement of the entire arm or leg in which the limb moves through all the anatomical planes. The circular motion of circumduction is a continuous sequence in which the limb moves forward (flexion), then moves out toward the side (abduction), then moves toward the back (extension), and then finally back to the body (adduction). (Circumduction is sometimes confused with rotation, but, as explained in the foregoing section, rotation generally occurs on the transverse plane.)

The shape that the movement of circumduction "draws" in space is conical: The arm or leg is held straight, and the hand or foot appears to be drawing an imaginary circle. The apex of the cone is at the proximal end of the limb, at the ball-and-socket joint, where the bone (either the humerus or the femur) is relatively stationary. The distal end of the limb (the hand or foot) makes the circular motion, creating the base of the cone. The movement of circumduction can be clockwise or counterclockwise, and the circular motion can be broad or narrow.

Circumduction can also occur at the wrist, the ankle, and the base of the thumb; the fingers can move circumductively at the knuckles of the hand (MCP joints).

Rotational Movements

MOVEMENT	MEANING	ORIGIN OF TERM
Lateral Rotation	Rotation *away from* the medial line of the body.	Latin *lateralis* = side + *rotare* = to revolve
Medial Rotation	Rotation *toward* the medial line of the body.	Latin *medialis* = of the middle + *rotare* = to revolve
Supination (SOO-pih-NAY-shun)	Rotational movement of the forearm in which the palm is facing forward or upward. In this position, the radius and ulna bones of the lower arm are parallel.	Latin *supinus* = lying on the back
Pronation (PRO-nay-shun)	Rotational movement of the forearm in which the palm is facing backward or downward. In this position, the radius crosses over the ulna, causing the two bones to form an X.	Latin *pronare* = to bend forward

Movements Within All Three Planes

MOVEMENT	MEANING	ORIGIN OF TERM
Circumduction (sir-kum-DUCK-shun)	Circular movement of an arm, leg, hand, foot, or finger that draws an imaginary circle in space	Latin *circum* = around + *docere* = to lead, to draw

Special Anatomical Movements

A number of movements that occur at specific joints do not correspond to the other categories of anatomical movement. These special movements include movements of the foot, hand, shoulders, and jaw.

SPECIAL MOVEMENTS OF THE FOOT

Inversion and *eversion* are movements of the foot in which the sole turns inward and then outward. Some authorities consider these movements to be forms of supination (inversion) and pronation (eversion). Inversion and eversion occur on the coronal/frontal plane, because the sole is turning inward toward the medial line and then turning away from the medial line.

The other special movements of which the foot is capable are *plantar flexion* and *dorsiflexion*. (These terms can cause some confusion because they both contain the word *flexion*). In plantar flexion, the foot moves at the ankle joint to point downward. The foot of a ballet dancer when *en pointe*—poised on the tips of the toes—provides an example of the foot in full plantar flexion. Dorsiflexion is the lifting movement of the foot in which the toes point upward and the heel downward. This particular movement occurs while walking, when a person drops the heel when taking a step to prevent the toes from scraping the ground. Some authorities consider plantar flexion and dorsiflexion to be flexion and extension movements of the foot on the sagittal plane.

SPECIAL MOVEMENTS OF THE THUMB

Unlike any other animal, human beings have *opposable* thumbs, which allow us to grasp objects securely and to perform intricate tasks with our hands. *Opposition* is the movement of the thumb across the palm to touch the tip of any finger. The movement of the thumb returning to its normal position (or the anatomical position) is referred to as *reposition*.

SPECIAL MOVEMENTS OF THE SHOULDERS

The movements of *protraction* and *retraction* are forward and backward motions occurring on a transverse plane. Protraction of the shoulder girdle, which involves the forward movement of the scapula bones (and is also known as abduction of the scapula bones), occurs when the shoulders "hunch"—as they do when people cross their arms, slump forward while sitting in a chair, or reach forward in an exaggerated way. Retraction of the shoulder girdle involves a backward motion of the scapula bones (and is also known as adduction of the scapula bones). When the shoulders are thrown back, the scapula bones move closer to the vertebral column. Retraction occurs when someone "squares" his or her shoulders and in the military pose of attention.

The shoulders are also capable of upward and downward motions, called *elevation* and *depression*, respectively. When the shoulder girdle lifts upward (elevation), the outer ends of the clavicles (collarbones) tilt up, bringing the scapula bones (shoulder blades) and humerus (upper arm bone) with them. (The common name for this movement is *shrugging the shoulders.*) The movement of depression is the opposite—the downward movement of the shoulder girdle as the shoulders return to their normal position.

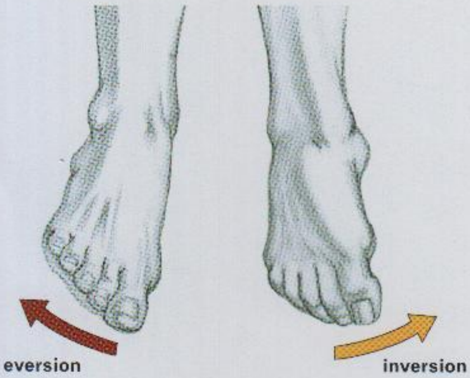
SPECIAL MOVEMENTS OF THE JAW

The jaw is also capable of protraction/retraction and elevation/depression. Protraction of the lower jaw is the jutting-forward motion of the jaw (also called protrusion), in which the chin and lower lip thrust forward. Retraction of the lower jaw (also called retrusion) is the backward motion in which the chin and lower lip are tucked back.

Depression of the lower jaw happens when the mouth opens and the jaw drops. Elevation of the jaw is the upward movement as the mouth closes and the jaw returns to its normal position.

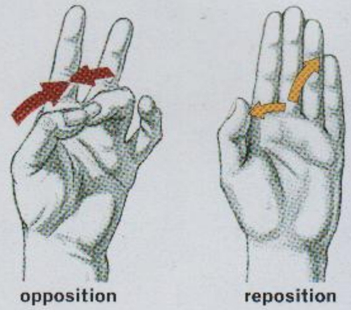
Special Anatomical Movements

MOVEMENT	MEANING	ORIGIN OF TERM
Inversion	Movement of the foot in which the sole turns *inward,* or medially (toward the medial line of the body)	Latin *invertere* = to turn about, to turn over
Eversion (ee-VER-zhun)	Movement of the foot in which the sole turns *outward,* or laterally (away from the medial line of the body)	Latin *evertere* = to turn out, to twist about
Plantar Flexion (PLAN-tar FLEK-shun)	Movement of the foot from the ankle joint in which the foot and toes point *downward*	Latin *planta* = sole of the foot + *flectere* = to bend
Dorsiflexion (door-sih-FLEK-shun)	Movement of the foot from the ankle joint in which the top (dorsum) of the foot is lifted with the toes pointing *upward*	Latin *dorsum* = back + *flectere* = to bend
Opposition	Movement of the thumb in which the pad of the thumb touches the tip of another finger	Latin *opponere* = to oppose
Reposition	Movement of the thumb from opposition back to the anatomical position	Latin *re* = back + *ponere* = to place
Elevation	Movement of a body part *upward* (in a superior direction)	Latin *elevare* = to raise, to lift
Depression	Movement of a body part *downward* (in an inferior direction)	Latin *deprimire* = to press down
Protraction	Movement of a body part forward (in an anterior direction); also called protrusion	Latin *pro* = forward + *trachere* = to draw
Retraction	Movement of a body part backward (in a posterior direction); also called retrusion	Latin *re* = back + *trachere* = to draw

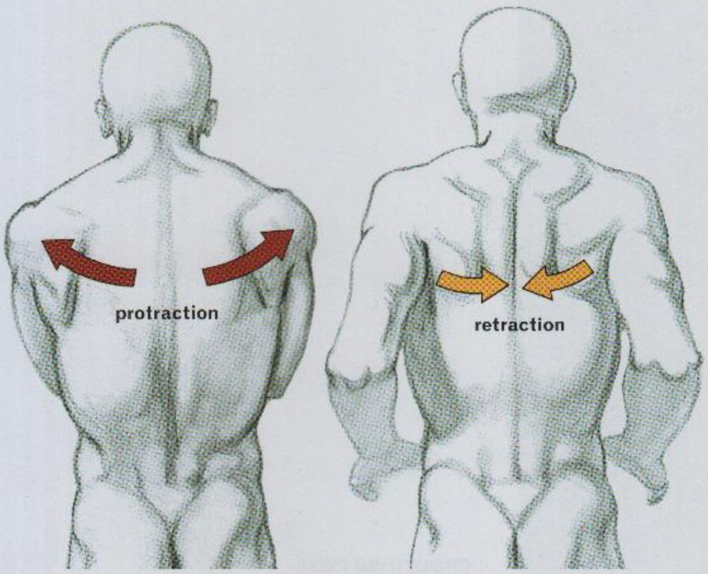


Movement of ankle joint (inversion and eversion)

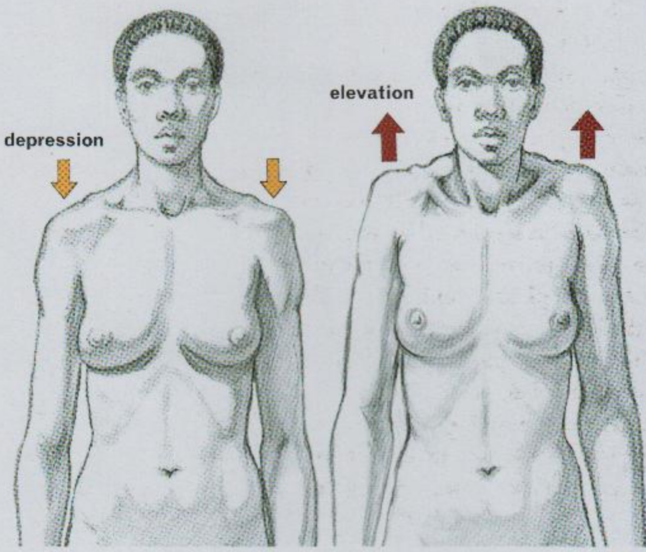
Movement of ankle joint (plantar flexion and dorsiflexion)



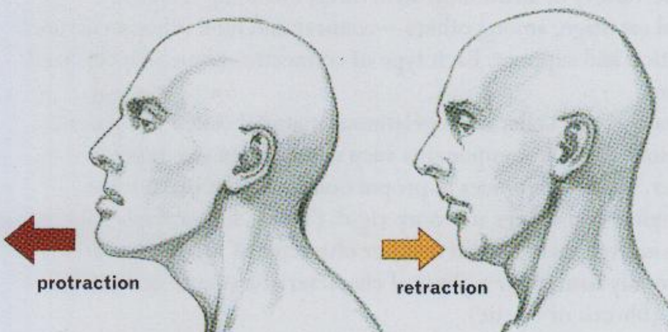
Movement of thumb joint (opposition and reposition)



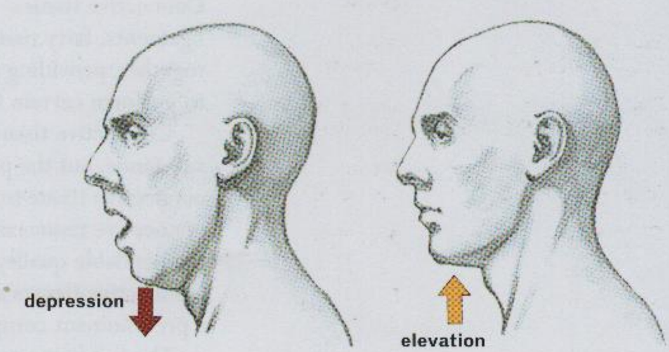
Movement of shoulder girdle (protraction and retraction)



Movement of shoulder girdle (depression and elevation)

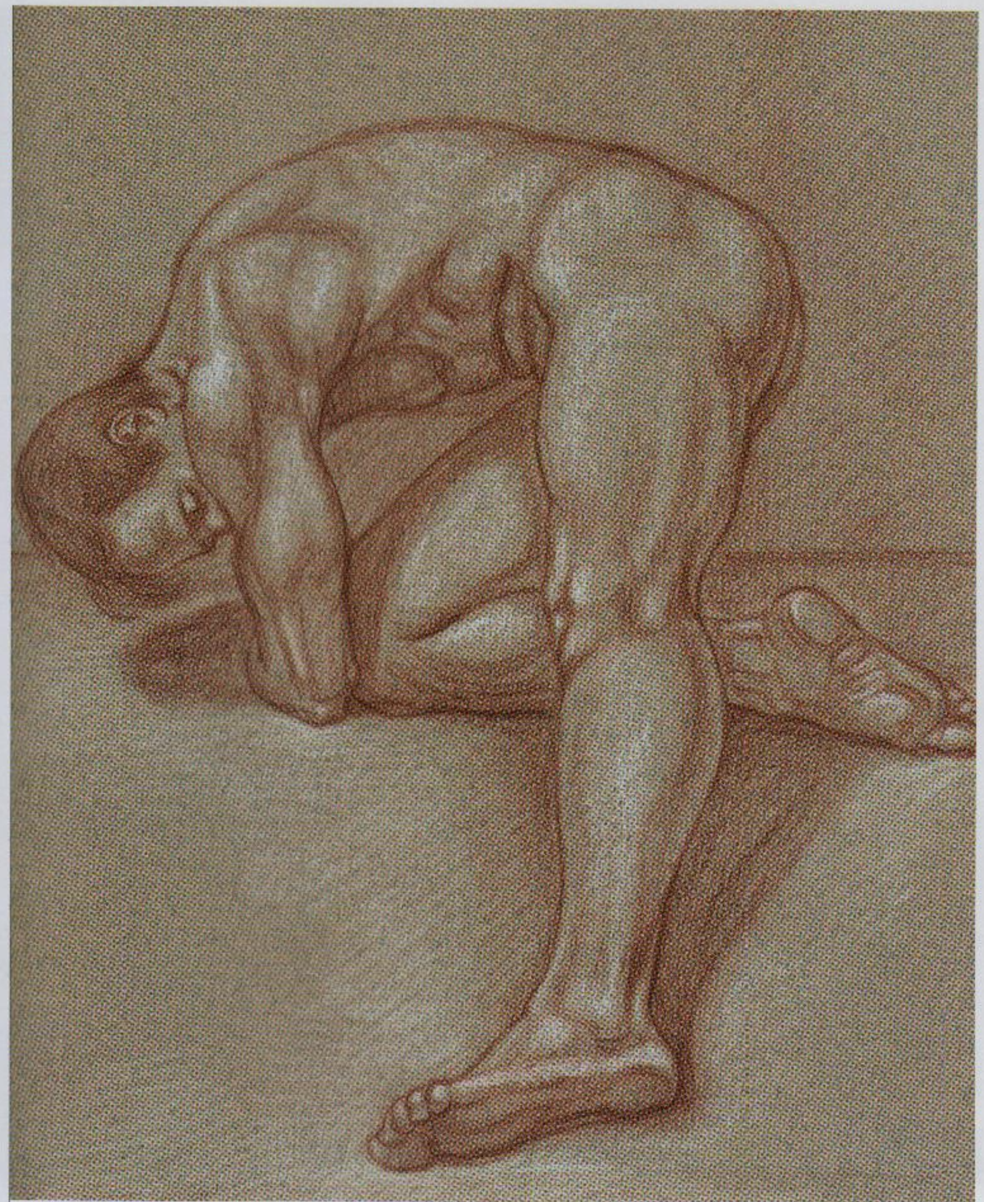


Movement of jaw (protraction and retraction)



Movement of jaw (depression and elevation)

SPECIAL ANATOMICAL MOVEMENTS



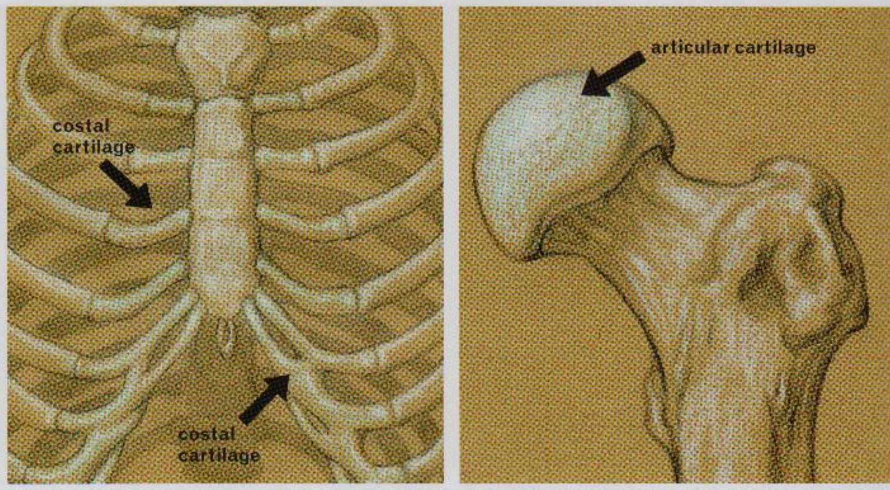
CROUCHING POSE

Connective Tissues

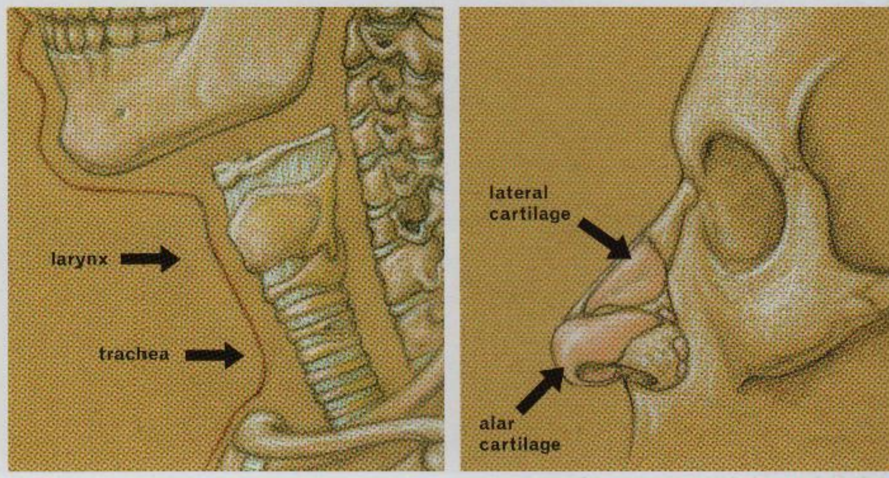
Connective tissues—a wide variety of anatomical structures, including tendons, ligaments, fatty tissues, and cartilage, among others—connect and bind other structures together, providing protection and support. Each type of connective tissue is specialized to perform certain functions.

Connective tissues contain fibers, cells, and a gelatinous material called the ground substance, but the proportions of these components vary widely from one type of connective tissue to another. These differences in proportions are what make some connective tissues more flexible and others are more rigid. (Think, for example, of the bendable quality of the ear versus the much tougher character of the ribcage arch.) Connective tissues are generally named for a physical characteristic (dense or loose) or a predominant component (fibrous or elastic).

The following pages contain just a small selection of the many types of connective-tissue structures. These particular structures—and the terms that name them—are, however, the ones that artists will most benefit from knowing, because they help one understand the anatomical form and movement of the human figure. (By the way, bone is also considered a connective tissue, but the skeletal system is dealt with separately, in a later section of this chapter.)



Left: Costal cartilages of ribcage. Right: Articular cartilage of joint surfaces of bones.



Left: Voice box (larynx) and windpipe (trachea). Right: Cartilage of nose.
HYALINE CARTILAGE

Cartilage

Cartilage is a connective tissue found in several areas of the body. There are many types of cartilage, which differ in composition and perform a variety of functions. Some support body structures while others provide smooth, wear-resistant surfaces at joints to reduce friction during movement. Disc-shaped cartilage pads act as shock absorbers between some bones. One type of cartilage, known as temporary cartilage, makes up most of the embryonic skeleton, allowing the fetus to remain flexible in the womb and during birth. Temporary cartilage is eventually replaced by bone tissue (calcified bone matrix) through a process called ossification.

Permanent cartilage (cartilage that does not become ossified) is found in the external structure of the ear, nose, windpipe (trachea), voice box (larynx), and the pads between the vertebra (intervertebral discs). It also connects the ribs to the breastbone (sternum) and serves as a smooth coating over the ends of bones, where they connect as joints.

There are three main types of permanent cartilage: *hyaline cartilage, fibrocartilage,* and *elastic cartilage*. These three types, each of which is discussed in greater detail below, differ in hardness and elasticity/resilience.

Hyaline Cartilage

Hyaline cartilage is the commonest, hardest type of cartilage found in the body. It has a glassy, bluish appearance and is extremely strong yet flexible and elastic. The hyaline cartilage that connects the ribs to the sternum is called *costal cartilage*; it creates the form of the ribcage arch (thoracic arch) seen on the anterior surface of the torso. A specialized hyaline cartilage, called *articular cartilage,* covers the joint surfaces of bones; this smooth, glossy surface helps reduce friction during the joints' movement. Hyaline cartilage also forms the voice box (larynx) and creates the C-shaped rings in the tubular form of the windpipe (trachea). Parts of the nose are composed of sturdy yet flexible hyaline cartilage (called the *alar cartilage of the nose* and the *lateral cartilage of the nose*).

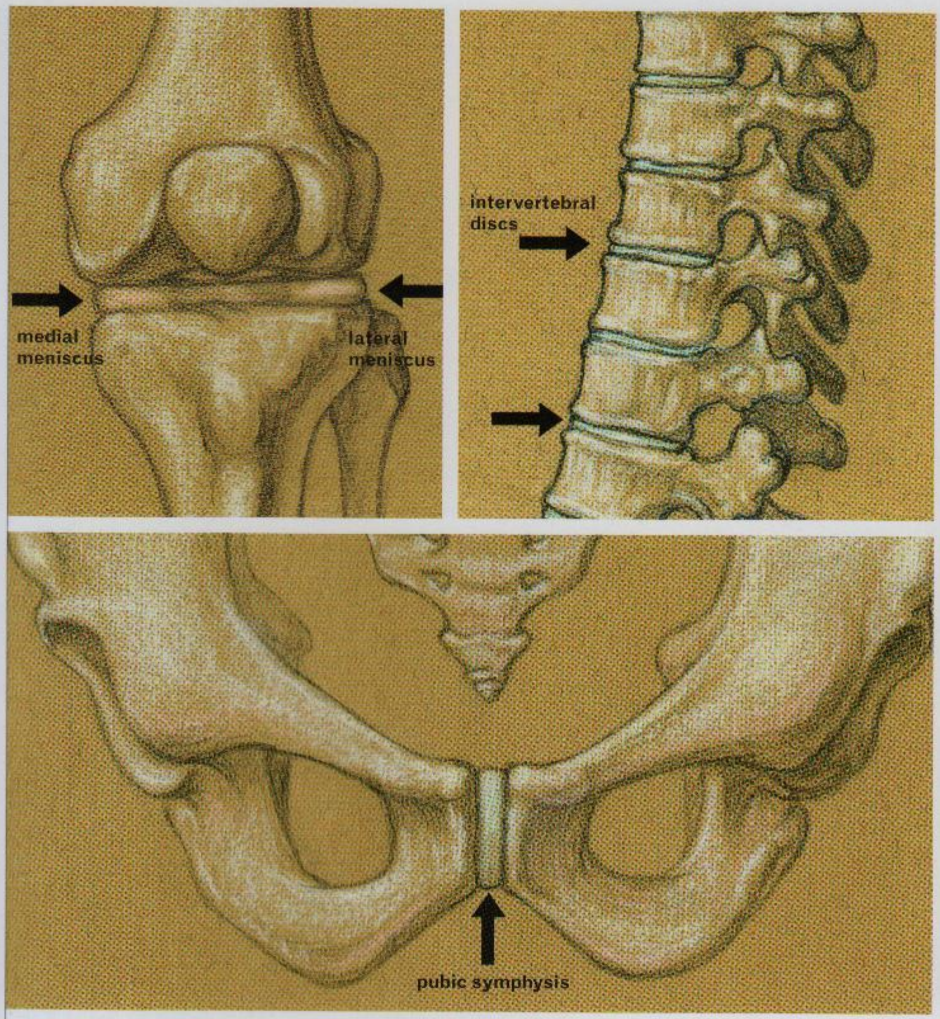
Cartilage

ORIGIN OF THE TERM
Latin *cartilago* = gristle

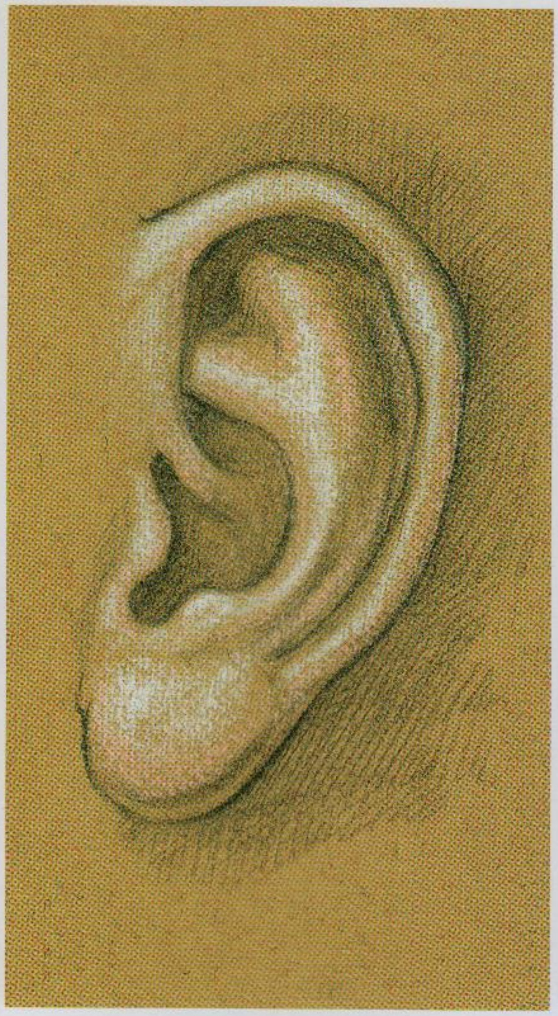
Hyaline Cartilage

PRONOUNCIATION
HI-uh-lin KAR-tih-lij

ORIGIN OF THE TERM
Greek *hyalos* = glass



FIBROCARTILAGE
Top left: Menisci cartilage of knee joint. Top right: Intervertebral discs of vertebral column. Bottom: Pubic symphysis—fibrocartilage disc of pelvis



ELASTIC CARTILAGE
Cartilage of the ear

Fibrocartilage

Extremely durable and resistant to strong compression, fibrocartilage forms discs or pads between certain joints. At the knee joint, positioned above the tibia of the lower leg, are crescent-shaped fibrocartilage pads called the *menisci* (singular, *meniscus*); these cushion against shocks in this very vulnerable joint. Also, fibrocartilage pads (called *intervertebral discs*) are positioned between the vertebrae in the spinal column. A fibrocartilage pad called the *pubic symphysis* lies between the two pubic bones of the pelvis.

Elastic Cartilage

Elastic cartilage is more flexible than the other types of cartilage. Extremely resilient, elastic cartilage can return to its original shape after being compressed or distorted. The entire external ear is composed of elastic cartilage.

Fibrocartilage

PRONOUNCIATION
FI-bro-KAR-tih-lij

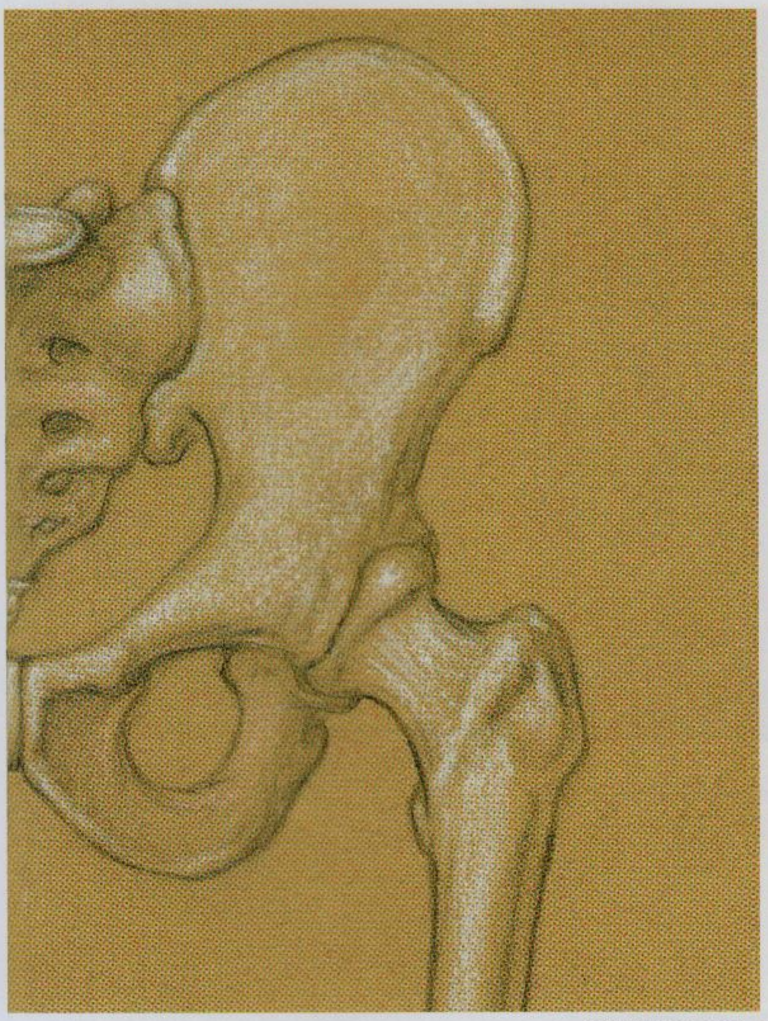
ORIGIN OF THE TERM
Latin *fibra* = fiber + *cartilago* = gristle

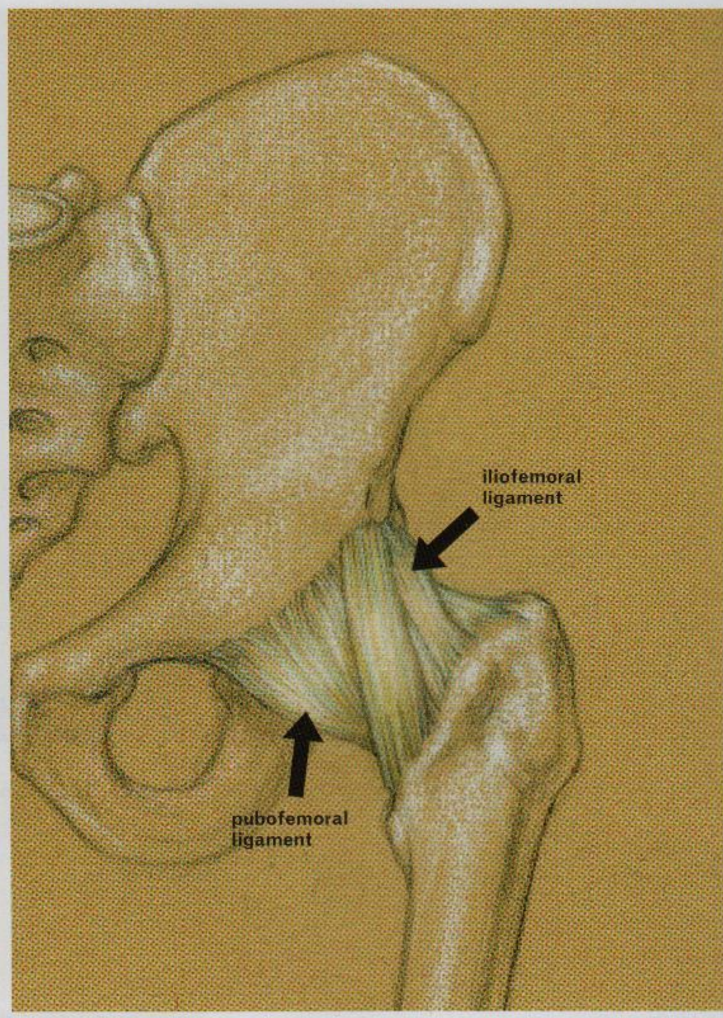
SYNONYMS
fibrocartilago, white fibrocartilage

Elastic Cartilage

ORIGIN OF THE TERM
Greek *elunein* = to drive, to set in motion

SYNONYMS
yellow cartilage, yellow fibrocartilage





LIGAMENTS ON A SYNOVIAL JOINT
Anterior view of pelvis and femur

Ligaments

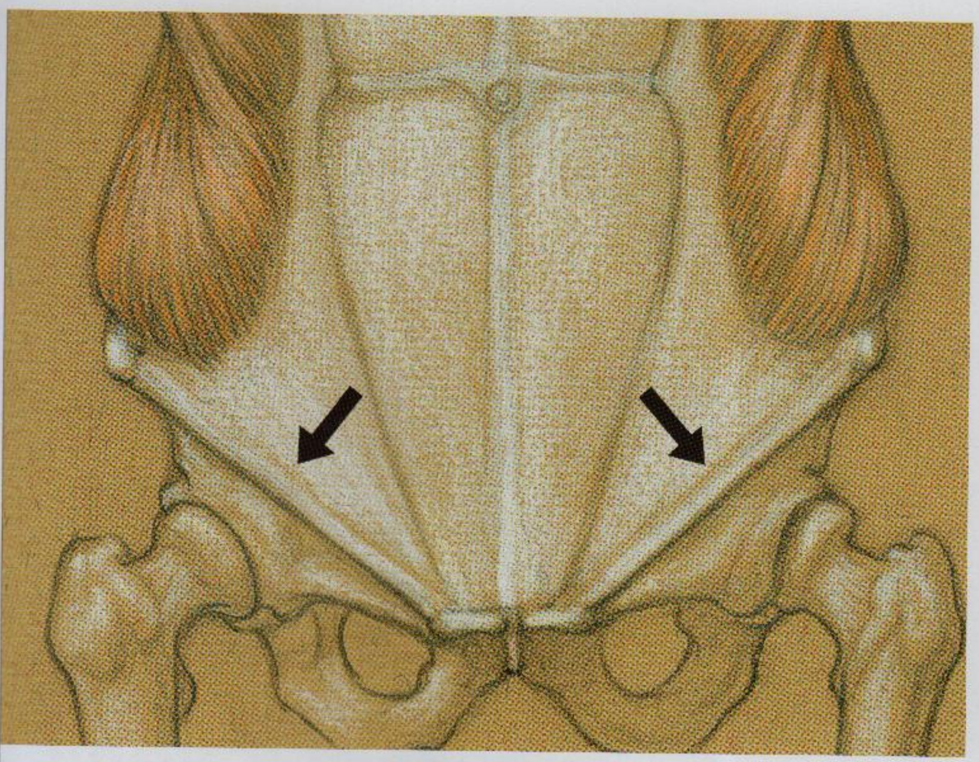
Ligaments are bands or sheets of dense fibrous connective tissue. They act as tough straps, surrounding the joints and binding bones to other bones (or to other structures). While their primary function is to hold the attached bones firmly in place, they also allow a limited range of movement. Ligaments hold the skeleton together and strengthen and stabilize the joints, preventing them from moving excessively or becoming dislocated (getting "out of joint"). Usually, ligaments are covered by muscles and other structures, making them hard to locate on the surface form, but a few are noticeable near the skin.

Ligaments on Synovial Joints

Most synovial joints (freely movable joints; pron., sih-NO-vee-ul) are enclosed within a fibrous joint capsule held together by ligaments. The ligaments reinforce the external surface of the joint capsule and help strengthen the joint. The drawings above show how ligaments attach to a synovial joint. The drawing on the left shows the ball-and-socket joint of the hip without any connective tissues. The drawing on the right shows the iliofemeral and pubofemeral ligaments attached to the pelvis and the femur bone of the upper leg.

Ligaments

ORIGIN OF THE TERM
Latin *ligamentum* = band, bandage



INGUINAL LIGAMENT
Anterior view of pelvis with inguinal ligament and aponeurosis of the external oblique muscle

Inguinal Ligament

PRONOUNCIATION
ING-gwih-nul LIG-uh-ment

ORIGIN OF THE TERM
Latin *inguen* = groin

SYNONYMS
arcus inguinalis (TA), ligamentum inguinale (TA), Poupart's ligament, fold of the groin, crucal arch

Inguinal Ligament

The inguinal ligament (of which there are a pair) is a fibrous band formed by the thicker lower border of a fibrous sheathing called the aponeurosis of the external oblique muscle. The two bands, one on each side of the pelvis, extend from the bony protrusions of the pelvis (called the *anterior superior iliac spine,* or *ASIS*) and are anchored in the pubic bone near the medial line. These ligaments create a subtle curve or angular crease on the skin in the lower abdominal area; this crease is sometimes referred as the *fold of the groin.*

Nuchal Ligament

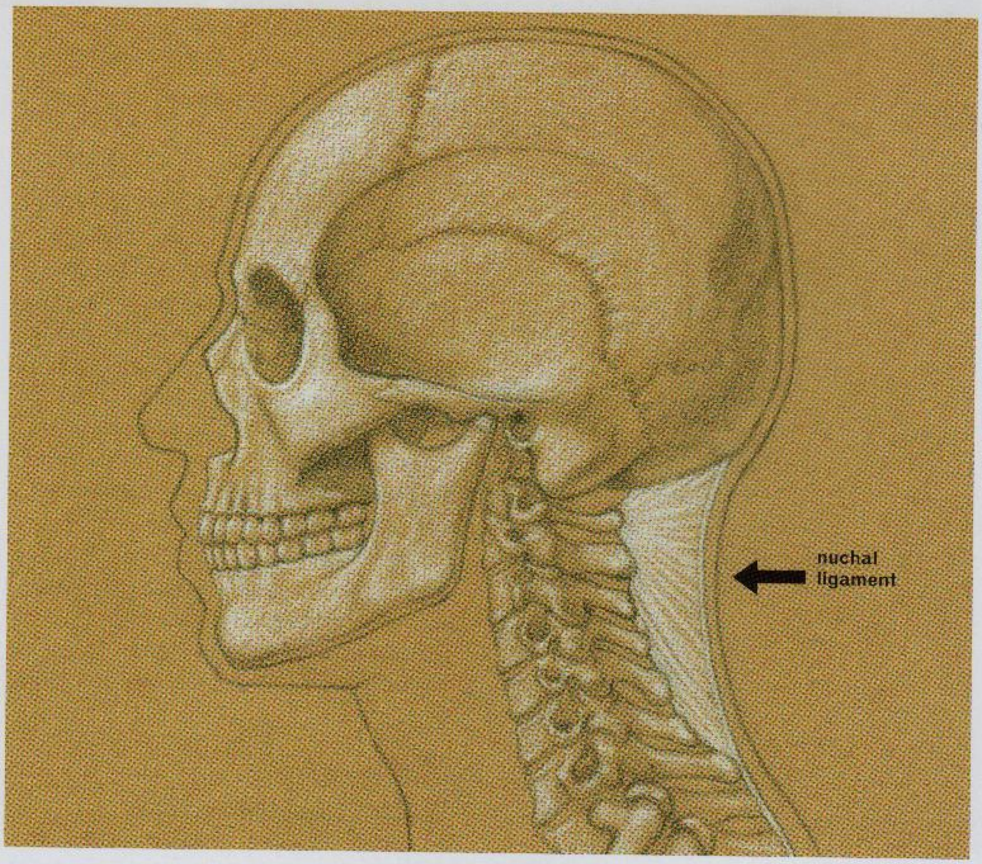
The nuchal ligament is a flat, triangular, sail-like ligament, composed of elastic connective tissue, that attaches to the base of the skull and then connects along the small bony projections (called spinous processes) of the cervical vertebrae. Sturdy and tough, the nuchal ligament helps stabilize the skull on the cervical vertebrae and provides an area for muscle attachments. The apex of the ligament's inverted triangle inserts into the seventh cervical vertebra. It is here—at the seventh vertebra—that one first sees the cervical vertebrae protrude on the surface form; the other cervical vertebrae of the neck are shorter and are hidden by the nuchal ligament.

Nuchal Ligament

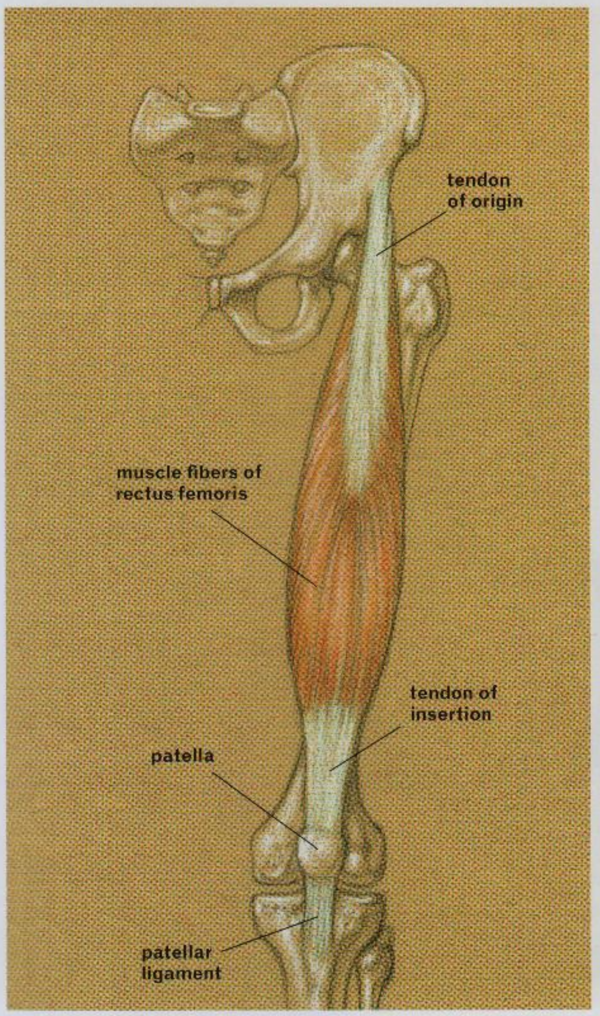
PRONOUNCIATION
NEW-kull LIG-uh-ment

ORIGIN OF THE TERM
Latin *nucha* = nape of neck

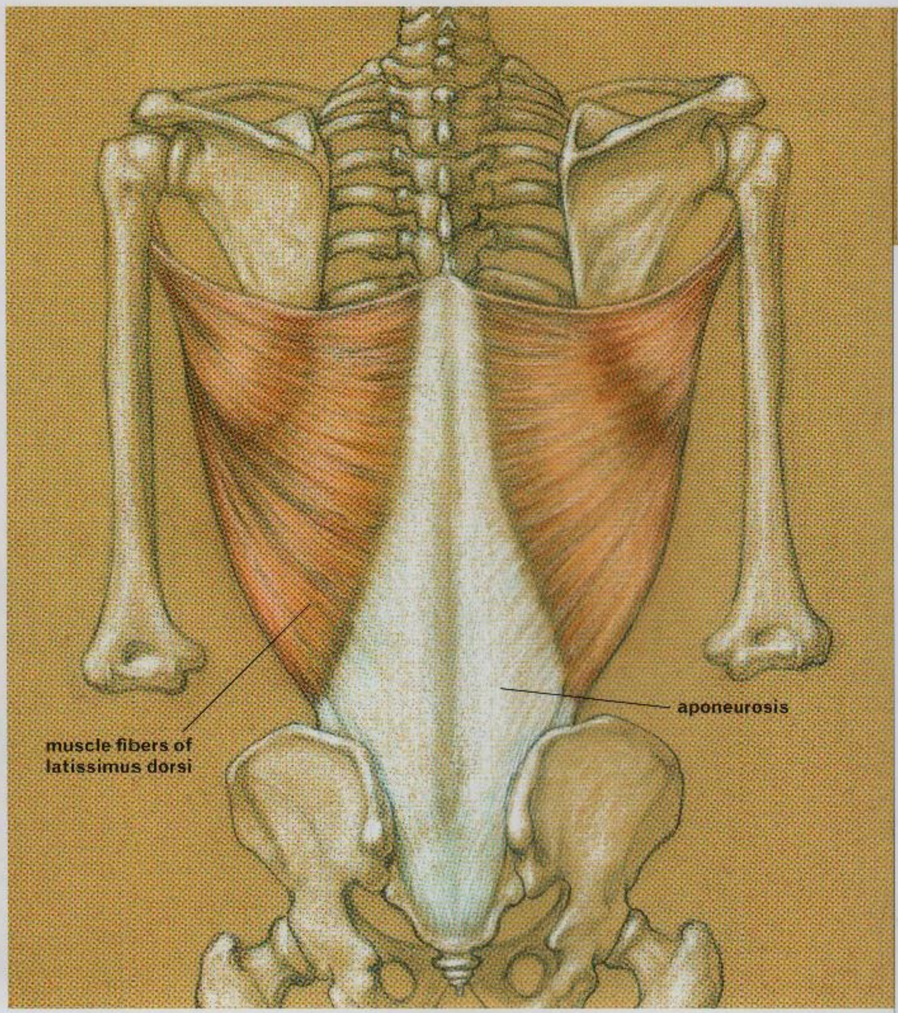
SYNONYMS
ligamentum nuchae (TA), posterior cervical ligament



NUCHAL LIGAMENT
Lateral view of cranium and cervical vertebrae with nuchal ligament



TENDON
Anterior view of pelvis, femur, and part of tibia and fibula with rectus femoris muscle of quadriceps (upper left leg)



APONEUROSIS
Posterior view of torso with aponeurosis of latissimus dorsi muscle

Tendons

Tendons are fibrous cords or bands that are part of the fleshy muscle. The function of tendons is to attach the muscles on bones or other structures. It is important to keep in mind that the muscles themselves do not attach directly on bones. As muscles contract (shorten), the tendons act as cables pulling on the bony levers to create movement.

The cords and bands of tendons vary in width and length; some tendons (particularly the more cordlike structures) are easily detected on the surface form, especially when there is tension in the muscles. The long tendons on the dorsal side of the hand, which clearly appear on the surface when someone spreads his or her fingers apart in a forceful manner, provide an example.

Aponeurosis

Aponeurosis is dense fibrous connective tissue—a broad, flat sheathing or expanded tendon that attaches muscles to bones or, in some cases, to other structures. The broad width of the sheathing allows for a wider area of attachment. Relatively thin, the sheathing also covers other muscles.

Tendons

ORIGIN OF THE TERM
Latin *tendere* = to stretch, to extend

SYNONYMS
tendo (TA), sinew

Aponeurosis

PRONOUNCIATION
AP-oh-new-ROH-siss

ORIGIN OF THE TERM
Greek *apo* = from + *neuron* = sinew

LARGE SEATED NUDE

Fascia

Fascia is a connective tissue that is best described as a fibrous membrane. There are two types of fascia—*superficial fascia* and *deep fascia*. The similarity of these terms may cause confusion. Superficial fascia is located under the skin (and contains fatty tissue); deep fascia (devoid of fat) is located under the superficial fascia layer. When the term *fascia* is used by itself, it is understood to mean deep fascia.

Superficial Fascia

Superficial fascia is the layer of loose fibroelastic connective tissue underneath the skin that contains mostly fatty tissue (also known as subcutaneous fat; see opposite). This layer influences the organic shape of the body on the surface. Even in muscularly defined individuals, the forms are always slightly softened because of small amounts of adipose tissue (fatty tissue) within the superficial fascia. The more fatty tissue present within the superficial fascia, the more it alters the shape of the body superficially.

Deep Fascia

Deep fascia is a thin, fibrous membrane, devoid of fat, that wraps around individual muscles and groups of muscles and binds them together in thin sheets, much like a body stocking. It helps hold the muscles in position.

Fascia

PRONOUNCIATION
FASH-ee-uh *or* FAY-shee-uh

ORIGIN OF THE TERM
Latin *fascia* = band, bandage

Superficial Fascia

SYNONYMS
hypodermis (TA), tela-subcutanea (TA), subcutaneous tissue, subcutaneous fascia, fibroelastic tissue, subcutaneous layer, fascia superficialis

Deep Fascia

SYNONYMS
fascia (TA), fasciae musculorum (TA), fascia of muscles, muscular fascia

LARGE FEMALE NUDE, RESTING

Subcutaneous Fat

Fat (or, more properly, *adipose tissue*) serves many purposes in the body, offering padding for protection, support for other structures, insulation against heat loss from the body, and storage of calories for the body to use as fuel reserves. Adipose tissue, composed mostly of fat cells, is found in many places throughout the body, including the superficial fascia layer under the skin, where it is known as subcutaneous fat.

The amount of subcutaneous fat varies from one part of the body to another and from body to body. It can be found in the soles of the feet; the palms of the hands; the tips of toes, fingers, and thumbs; the armpit region; the pubic area; the buttocks; the kneecap area; the back of the knee; some areas of the face; around the eyeballs; at the lower border of the chest muscle; and, in small amounts, at the "flank pads" on either side of the waist. Men tend to accumulate subcutaneous fat primarily in the abdomen (as when a man has a "beer belly"), the chest area (especially in obese men), the lower back, the buttocks, the neck, and the upper arms. Women tend naturally to have more fatty layers in the breasts, thighs, hips, buttocks, and abdomen for insulation and for fuel reserves needed during pregnancy.

The presence of fatty tissue influences the surface form of the figure no matter how thin a person is. When subcutaneous fat is more prevalent, it tends to conceal muscular forms and create a "fleshy" look. Being able to show the ways in which fleshy areas respond to movement—through compression or stretching—permits an artist to give a more natural quality to the surface form.

Subcutaneous Fat

PRONOUNCIATION
SUB-kyu-TAY-nee-us

ORIGIN OF THE TERM
Latin *sub* = below + *cutanea* = the skin

SYNONYMS
panniculus adiposus (TA), fatty layer, fatty tissue, adipose tissue, subcutaneous tissue, subcutaneous layer

STUDY OF LARGE BACK

The Skeletal System

The study of the skeletal system is vital to artistic anatomy because the bones create the body's internal framework—the scaffolding to which the muscles and other soft tissues are attached. One way to think about the relationship between the skeletal system and the muscular system is to think of the bones as the body's "hardware" and the muscles and other softer structures as the body's "software." Without the hardware, the software cannot function.

Skeletal Structure, Surface Form, and Movement

Bones are complex, dynamic structures. Studying them gives us the opportunity to see the sculptural beauty of their shapes and to appreciate the function of each. But, beyond this, artists must be able to recognize the skeleton's structure within the body and to see the visual clues, or "bony landmarks," of the skeleton's presence as these appear on the surface of the body. Even though people have the same types of bones in their bodies, variations in these bones contribute to the differences between people and to each person's unique form. For example, of two people of the same age and gender, one might have a large, "chiseled" jaw and the other a smaller, more refined jaw. One person might have a broad ribcage (commonly called a barrel chest), while another has an average size thorax. These differences are even more apparent in the variations of bones lengths among people.

Understanding the body's skeletal framework also helps us understand the proportions of the human figure—and the differences in how people are proportioned. While the height of an average adult today ranges from about five and half feet to more than six feet, the variation is actually much greater, with some adults being about three feet tall and others nearly eight feet tall. The key in assessing a person's skeletal proportions is to check the length of the cranium and compare that measurement to the other parts of the skeleton. The craniums (and torsos) of different people tend to be similar in size, whereas the lengths of the leg bones can vary.

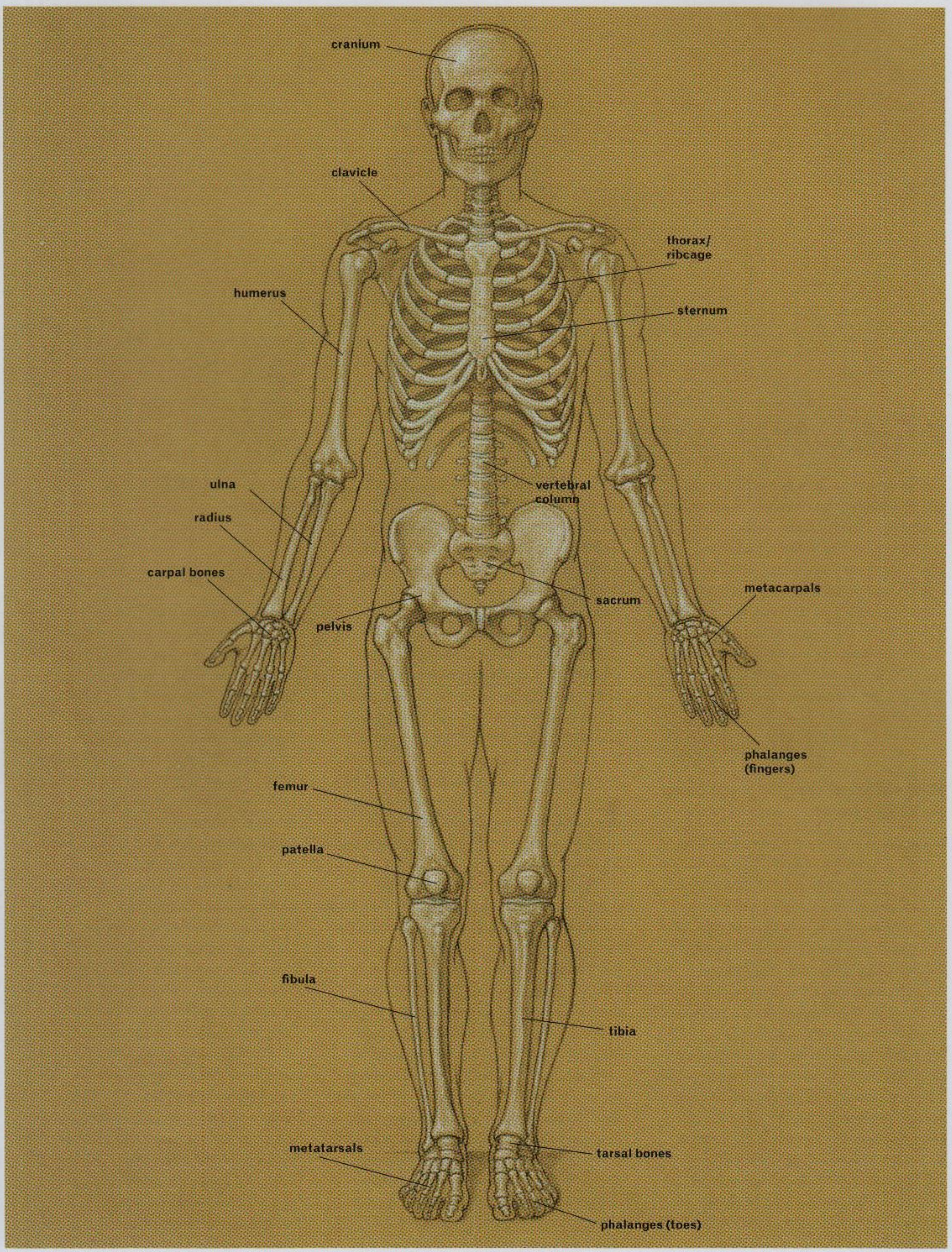
The number of bones in an adult human skeleton is approximately 206. This number, however, actually varies from the time of birth (when the newborn infant has 270 bones or more) to adolescence. The ossification process unites or fuses the many cartilaginous bones into single, ossified bones. The ossification process is usually completed in the late teens or early twenties. While it is not necessary for you to learn the names and forms of all these bones, it is essential that you become familiar with those bones that importantly contribute to the dynamics of movement and to the overall shape and structure of the human figure. Understanding the structure and basic mechanics of the skeletal system makes it easier to learn the muscular structures and to grasp the principles involved in the body's movement.

Bone Tissues

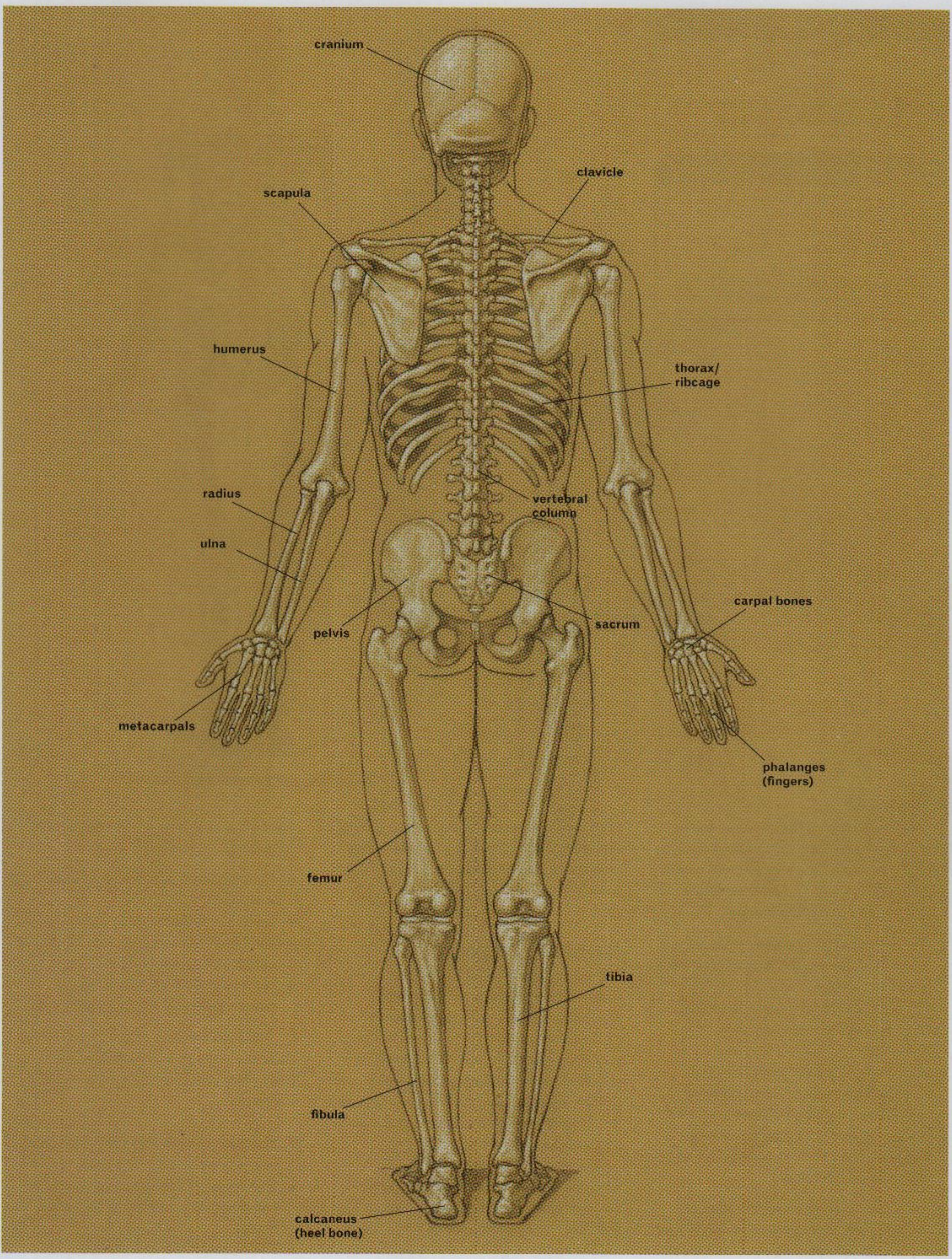
Bones are living tissues, not dead matter (as many people mistakenly think). They are the most specialized of all connective tissues. Each bone consists of an intercellular matrix of bone cells, collagen fibers, and inorganic mineral salts that rigidify the bones' structure.

Bones consist of two types of *osseous tissue*: *compact bone* and *spongy bone*. (The word *osseus* derives from the Latin word for bone, *os.*) Compact bone, which forms the outer surfaces of bones, is a very strong, very hard structure that can withstand the stresses put on bones, especially during movement. Spongy bone makes up the interior surface structure of bone. (Marrow cavities are found within spongy bone in certain parts of the skeleton.) The honeycombed quality of spongy bone gives bones their lightness and helps them absorb the shocks of intense movement.

The following pages describe various aspects of the skeletal system, including the classification of bones by shape, bones' surface features, and the classification of joints, as well as providing a breakdown of the different kinds of synovial (freely movable) joints that make the human figure's movement possible. But first, let us turn to the two basic groups of bones composing the human skeleton: the *axial skeleton* and the *appendicular skeleton*.



SKELETON, ANTERIOR VIEW



SKELETON, POSTERIOR VIEW

Axial Skeleton

ORIGIN OF THE TERM
Latin *axis* = axle

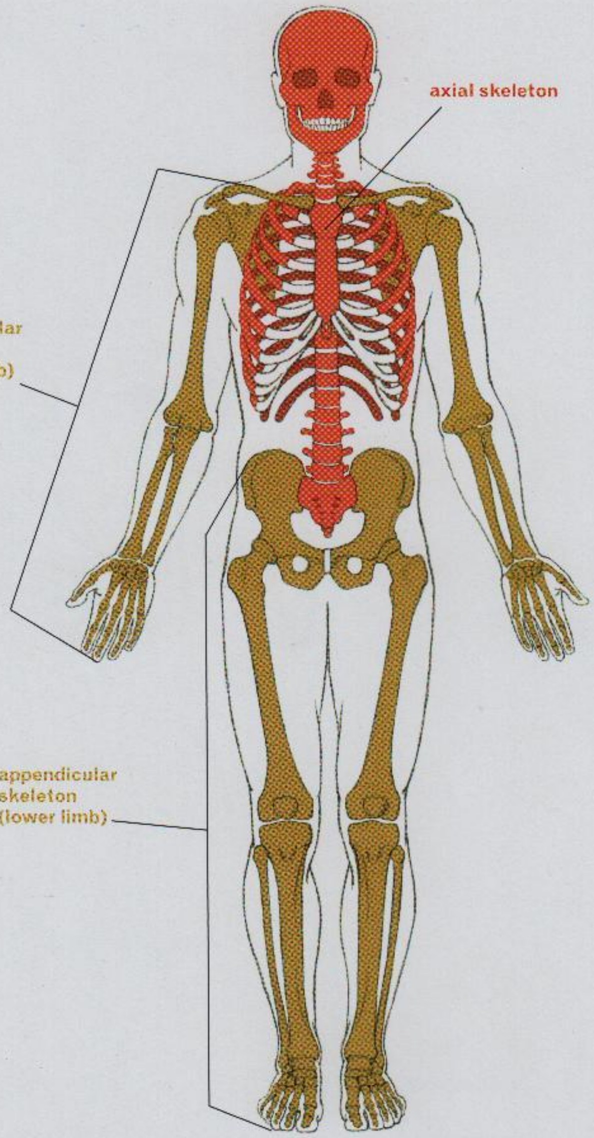
SYNONYMS
skeleton axiale (TA), skeleton of the trunk, central skeleton, axial region

Appendicular Skeleton

PRONOUNCIATION
AP-en-DIK-yoo-lar SKEL-uh-ton

ORIGIN OF THE TERM
Latin *appendere* = to add on

SYNONYMS
skeleton appendiculare (TA), appendicular region



AXIAL AND APPENDICULAR SKELETON

Axial Skeleton

The axial skeleton is the group of bones that forms the central axis of the body. Its primary function is to support and protect the internal organs. The axial skeleton consists of the following bones:

- The bones of the cranium, including all of the skull bones, the jaw, and the ear bones (ossicles)
- The hyoid bone (the U-shaped bone located below the jaw and above the voice box)
- The bones of the vertebral column, including the twenty-four vertebrae, the sacrum, and the tailbone (coccyx)
- The bones of the thorax, or ribcage, including the twenty-four ribs and the breastbone (sternum)

All these skeletal structures play a protective role: The cranium protects the brain and the sensory organs of the face; the vertebral column protects the spinal cord; and the bones of the thorax protect the lungs, heart, liver, spleen, and other internal organs as well as the major blood vessels.

Appendicular Skeleton

The appendicular skeleton is the combination of bones forming the appendages (upper and lower limbs) of the body, as well as the bones of the two bony girdles by which the limbs are attached to the axial skeleton. (These two girdles are the *shoulder girdle,* or pectoral girdle, of the ribcage region and the *pelvic girdle* of the hip region.)

The primary functions of the appendicular skeleton are to allow the movement of the limbs and to support and move the axial skeleton.

The upper region of the appendicular skeleton—the shoulder girdle and those bones that attach to it—consists of the following:

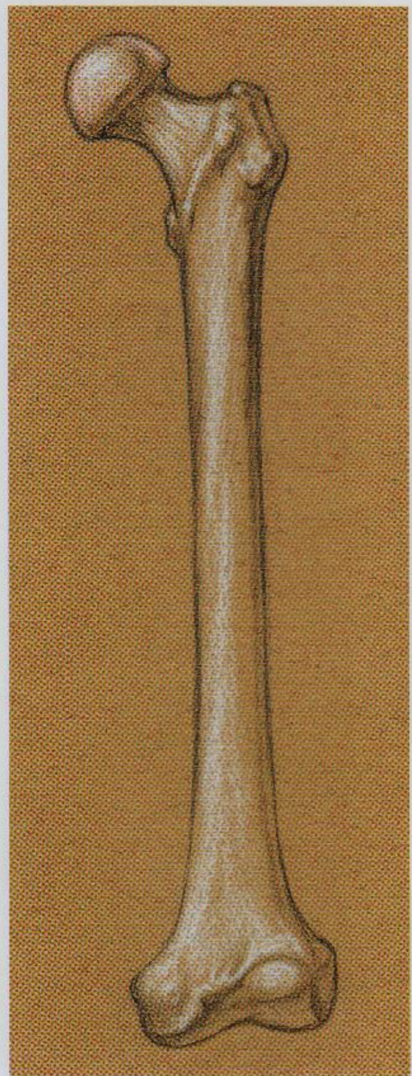
- The two scapula bones (shoulder blades)
- The two clavicles (collar bones)
- The bones of the upper arm (humerus) and forearm (ulna, radius)
- The bones of the hands (carpals, metacarpals) and fingers (phalanges)

The lower region of the appendicular skeleton—the pelvic girdle and those bones that attach to it—consists of the following:

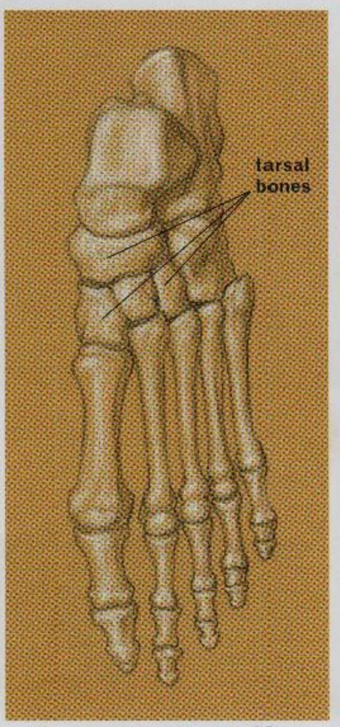
- The two pelvic bones (the ossa coxae, or hip bones, excluding the sacrum)
- The bones of the upper leg (femur), knee (patella), and lower leg (tibia, fibula)
- The bones of the feet (tarsals, metatarsals) and toes (phalanges)

Long Bones	Flat Bones
SYNONYM os longum (TA)	SYNONYM os planum (TA)

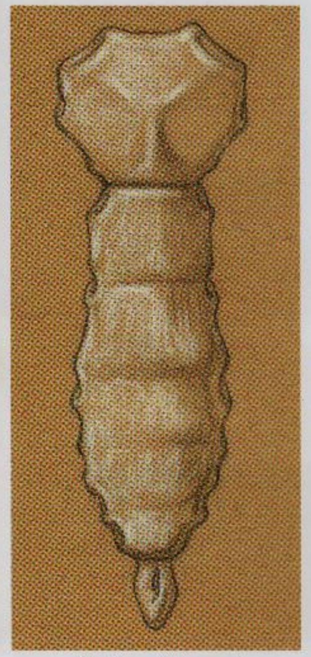
Short Bones	Irregular Bones
SYNONYM os breve (TA)	SYNONYMS os irregulare (TA), mixed bones



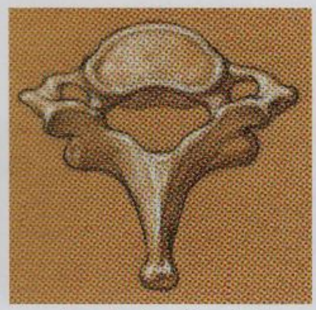
Long bone (femur bone of upper leg)



Short bone (tarsal bones of foot)



Flat bone (sternum)



Irregular bone (vertebra)

BONES CLASSIFIED BY SHAPE

Classification of Bones by Shape

Bones come in a variety of shapes and a range of sizes, all the way from the very large thigh bone (femur) to the tiny toe bones (phalanges). The shapes of bones can reveal their functions. The function of the femur is to withstand great stress, while the sternum (breastbone) functions as a shield-like form to protect the heart and lungs beneath.

There are four different classes of bones, distinguished by their general shape:

LONG BONES

Long bones are longer than they are wide and consist of an elongated, cylindrical shaft (*diaphysis*) and two expanded ends (*epiphysis*). Found in the limbs, long bones vary in size. They are slightly curved, and their forms tend to spiral, giving them more strength and enabling them to withstand stress. The enlarged ends help stabilize the joints and serve as wide bases for attachments of ligaments and muscle tendons. Long bones also serve as levers, making movement possible.

Examples of long bones include the femur, the tibia, the fibula, the humerus, the ulna, the radius, the clavicle, the metacarpals of the hand, and the metatarsals of the foot.

SHORT BONES

Short bones are about equal in length and width and tend to be roughly cube-shaped (cuboid). Because of their compact, compressed form, they act as shock absorbers.

Examples of short bones include the tarsal bones of the foot, the carpal bones of the hand, and the sesamoid bones (bones embedded within tendons, such as the patella, or kneecap).

FLAT BONES

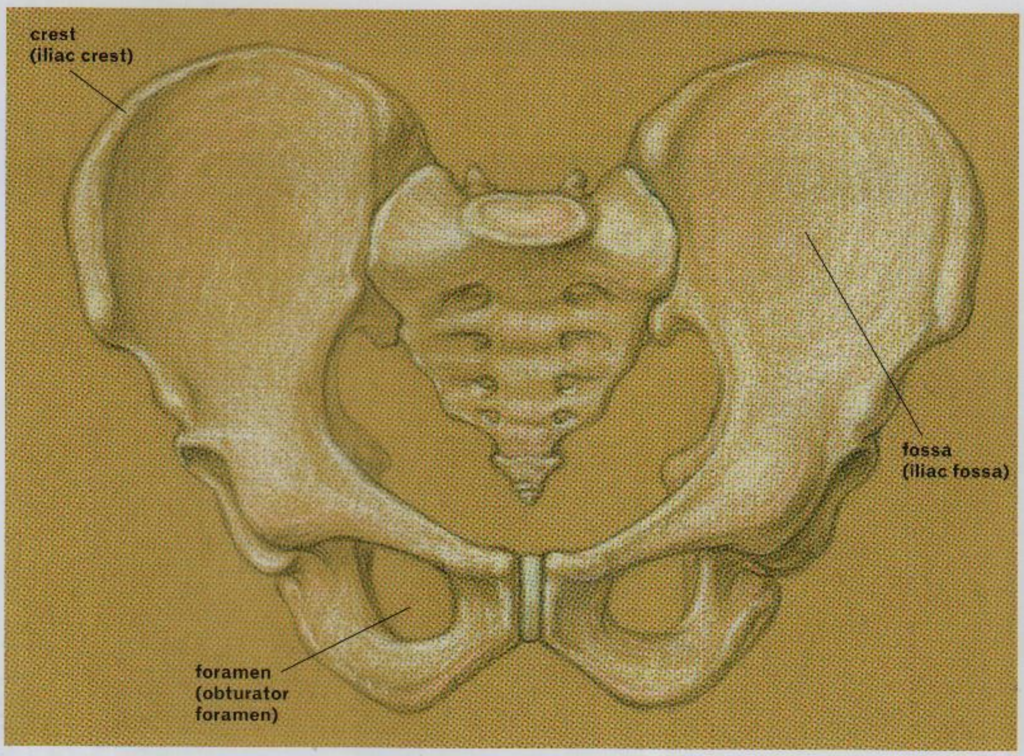
Flat bones are thin and somewhat curved in appearance. They provide a surface for attachment of muscles and function to protect underlying soft tissues.

Examples of flat bones include the sternum, the cranial bones, the ilium (of the pelvis), the scapula bones, and the ribs.

IRREGULAR BONES

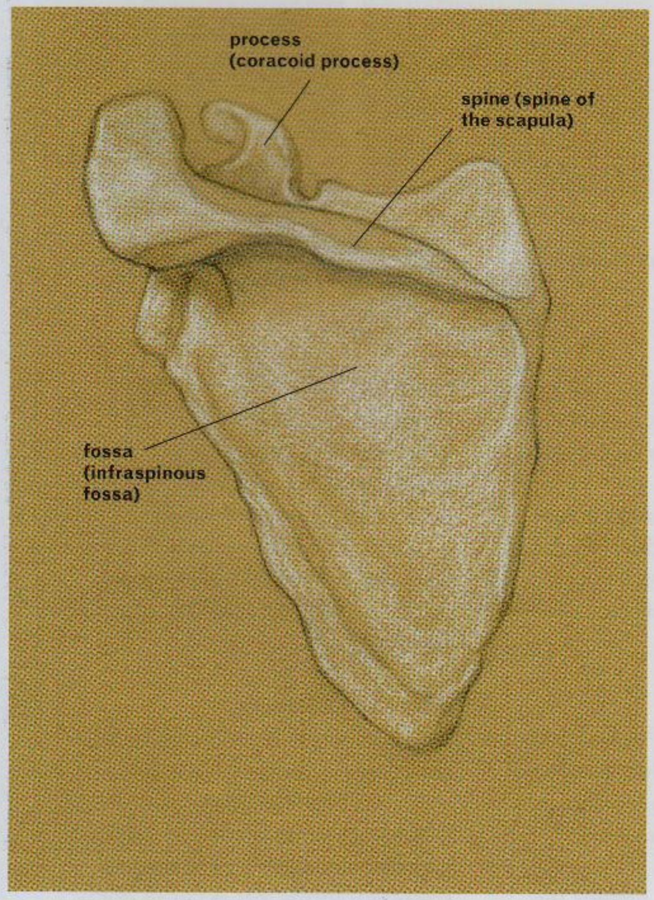
Irregular bones do not easily fit into the other categories because they have complex, intricate shapes. Any one of the vertebrae of the spinal column provides an example of the unique sculptural forms that occur in each irregular bone.

Examples of irregular bones include the vertebrae and the facial bones.

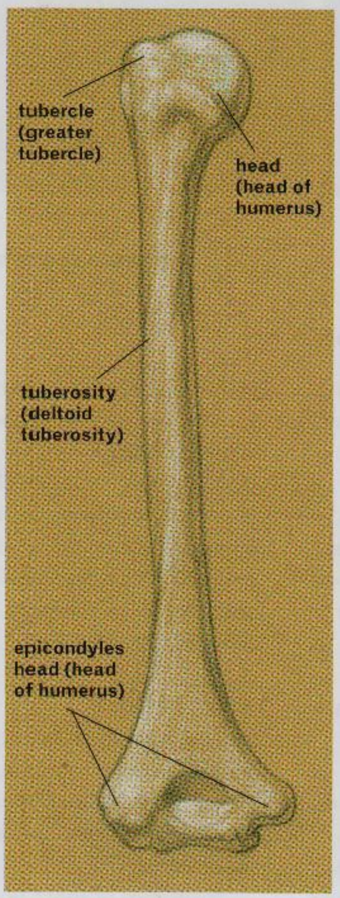


Pelvis (anterior view)

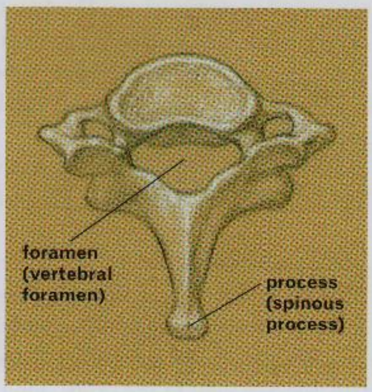
Femur
(posterior view of left upper leg bone)



Scapula (posterior view of left shoulder blade)



Humerus
(posterior view of left upper arm bone)



Seventh cervical vertebra
(superior view)

SURFACE FEATURES OF BONES

Surface Features of Bones

SYNONYMS
surface markings on bones, bone markings, features of bones, bone features, surfaces of bones, bone landmarks

Surface Features of Bones

The surfaces of bones have stories to tell. Textured bumps, sharp ridges, smooth projections, spiraling edges—bone surfaces display all these features, and each serves a particular function. Projections on bones are usually attachment sites for tendons and ligaments. Openings within the bone are passageways for blood vessels and nerves. Smooth features serve as articulating surfaces at joints, enabling certain kinds of movements. (Examples are the rounded ends of condyles, which allow for the smooth, hinge-like movement of certain joints.) A nonarticulating, or nonarticular, surface is an area of a bone that, although it is near an articulating surface, does not contribute to movement and serves primarily as an attachment site for tendons and ligaments. (Epicondyles—small projections of bone above or on condyles—are examples of nonarticulating surfaces.) By identifying the most important surface features of bones, the table below helps clarify the topography of the skeleton.

Surface Features of Bones

Projections for Tendon and Ligament Attachments

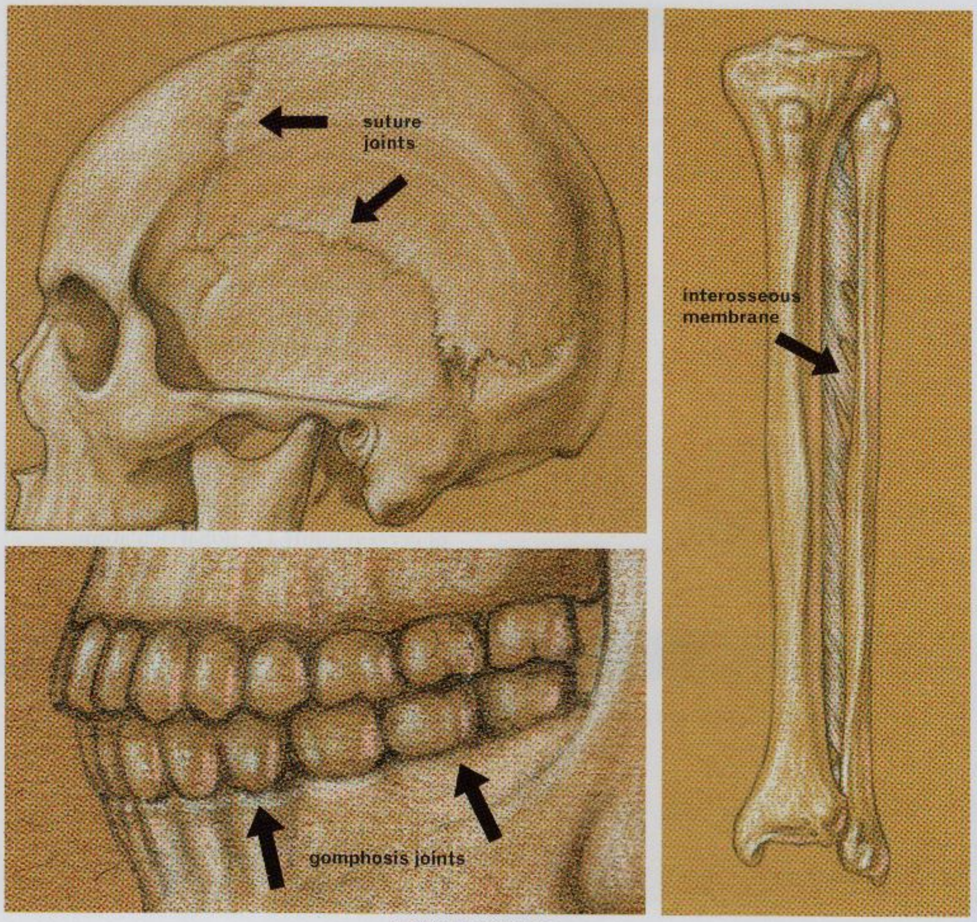
FEATURE	MEANING	ORIGIN OF TERM
Crest Synonyms: crista (TA), ridge	A narrow, prominent ridge	Latin *crista* = comb or tuft on the head of a bird
Epicondyle (ep-ih-KON-dial) Synonym: epicondylus (TA)	A small, nonarticular projection above a condyle	Greek *epi* = at, on, upon + *kondylos* = knuckle
Process Synonym: processus (TA)	A general term for any bony prominence	Latin *processus* = progress, process, an advance, a going forward
Protuberance Synonym: protuberantia (TA)	A protruding projection	Latin *protuberare* = to swell
Spine	A sharp, slender, pointed process	Latin *spina* = thorn, spine
Trochanter (troh-KAN-ter)	A very large, rough projection found only on the femur bone	Greek *trochanter* = a runner
Tubercle (TOO-burr-kul) Synonym: tuberculum (TA)	A small, rounded projection	Latin *tuberculum* = a swelling or knob
Tuberosity (TOO-burr-OSS-ih-tee) Synonym: tuberositas (TA)	A large, rounded projection that is sometimes rough in texture	Latin *turberosus* = full of bumps

Articulating Surfaces (Features That Help Form Joints)

FEATURE	MEANING	ORIGIN OF TERM
Condyle (KON-dial) Synonym: condylus (TA)	A rounded articular projection at the extremity of a bone; usually occurs in pairs	Latin *condylus,* from Greek *kondylos* = knob, knuckle
Facet	A small, shallow (nearly flat) articulating surface	French *facette* = little face
Head	A large, usually ball-shaped expansion at the end of a bone	—
Trochlea (TROCK-lee-uh)	A spool-like articulating surface that acts like a pulley	Greek *trochileia* = pulley

Depressions (for Muscles) and Openings (for Blood Vessels and Nerves)

FEATURE	MEANING	ORIGIN OF TERM
Foramen (foh-RAY-men)	A round or oval aperture (opening)	Latin *forare* = to pierce
Fossa (FOSS-ah)	A shallow, basin-like depression	Latin *fossa* = a ditch or trench



FIBROUS JOINTS
Top left: Suture joints (of cranium). Bottom left: Gomphosis joints (of teeth in sockets). Right: Syndesmosis joint (of tibia and fibula).

Joints

A joint, or articulation, is the junction or union of two or more bones. Joints are held together by connective tissue and, depending on the type of joint, may have surrounding structures as well, including cartilages, ligaments, and synovial membranes.

There are two ways of classifying joints:

- By the kind of connective-tissue material binding the joint together. In this classification scheme, there are three categories of joints: *fibrous joints, cartilaginous joints,* and *synovial joints.*
- By the degree of movement permitted by the joint. Again, there are three categories: *immovable joints* (synarthrosis [TA]), *slightly movable joints* (amphiarthrosis [TA]), and *freely movable joints* (diarthrosis [TA]).

Immovable joints (such as the sutures on the skull or the joints of the teeth within the sockets of the upper and lower jaw) are "locked" and are interesting to artists only from a structural point of view. Slightly movable joints (such as the intervertebral discs of the spinal column) do contribute to movement, but in a restricted way. Freely movable joints (which are synovial joints) are the most important to artists studying the dynamics of movement and gesture. The many different types of synovial joints contribute to the body's *range of motion (ROM)* capabilities. Synovial joints have a joint cavity, which is a capsule of connective tissue surrounding the joint to strengthen it and protect it during movement. Fibrous joints and cartilaginous joints do not have a joint cavity.

Fibrous Joints

Fibrous joints occur where bones are held together by fibrous connective tissue. The three types of fibrous joints are *suture joints, gomphosis joints,* and *syndesmosis joints.* The differences between these types have mostly to do with the length of the fibrous tissues. Suture and gomphosis joints are immovable; syndesmosis joints are slightly movable.

Cartilaginous Joints

Cartilaginous joints are located where bones are connected by cartilage material. There are two types of cartilaginous joints: *synchondrosis joints,* which are immovable, and *symphysis joints,* which are slightly movable.

Fibrous Joints

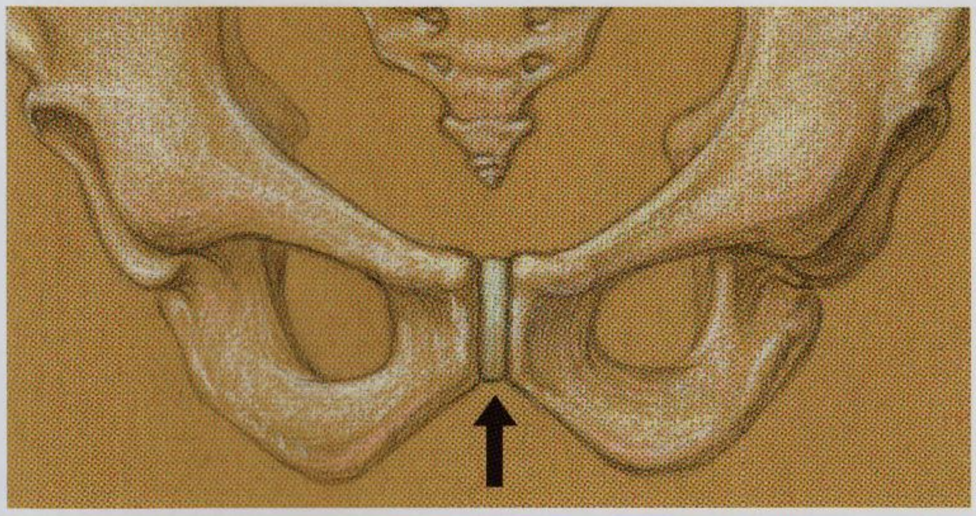
SYNONYMS
junctura fibrosa (TA), articulatio fibrosa

Cartilaginous Joints

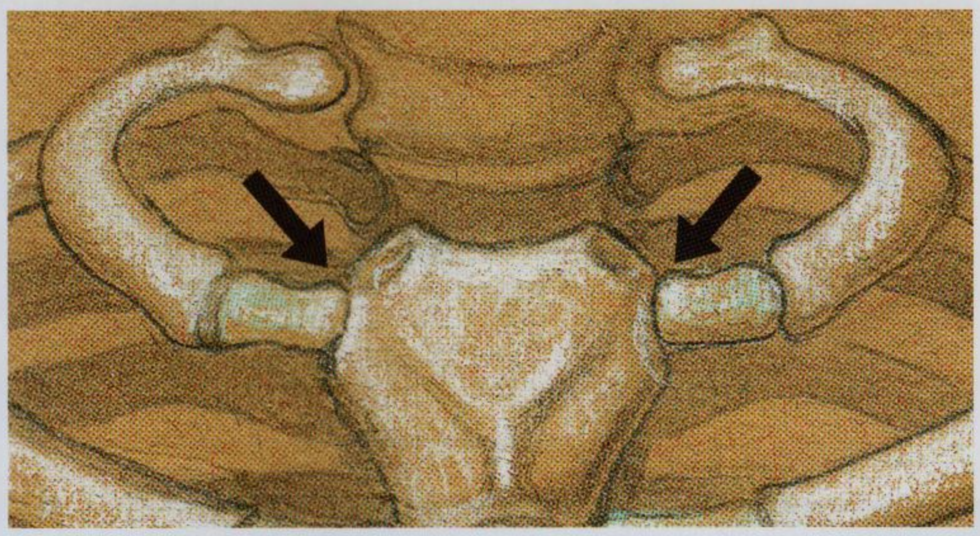
PRONOUNCIATION
KAR-tih-LAAJ-ih-nuss

ORIGIN OF THE TERM
cartilago = gristle

SYNONYMS
junctura cartilaginea (TA), articulatio cartilaginis, cartilaginous articulation



CARTILAGINOUS JOINTS
Symphysis joint (at pubic symphysis of pelvis)



CARTILAGINOUS JOINTS
Synchondrosis joint (at first rib and manubrium of sternum)

Fibrous Joints

JOINT	DESCRIPTION/EXAMPLES	ORIGIN OF TERM
Suture Joint Synonym: sutura (TA)	Saw-edged, beveled, or overlapping; very short fibers; immovable. Examples: suture joints of the skull.	Latin *sutura* = seam
Gomphosis Joint (gom-FOH-siss) Synonyms: syndesmosis dentoalveolaris (TA), dento-alveolar syndesmosis, socket	A "peg" in a socket; immovable. Examples: joints connecting the teeth to the upper and lower jaw bones.	Greek *gomphosis* = a nailing together Greek *syndesmos* = a fastening
Syndesmosis Joint (SIN-dez-MOH-siss)	Combines slight movability with strength. Examples: interosseous membranes between the radius and ulna bones of the lower arms and the tibia and fibula bones of the lower legs.	

Cartilaginous Joints

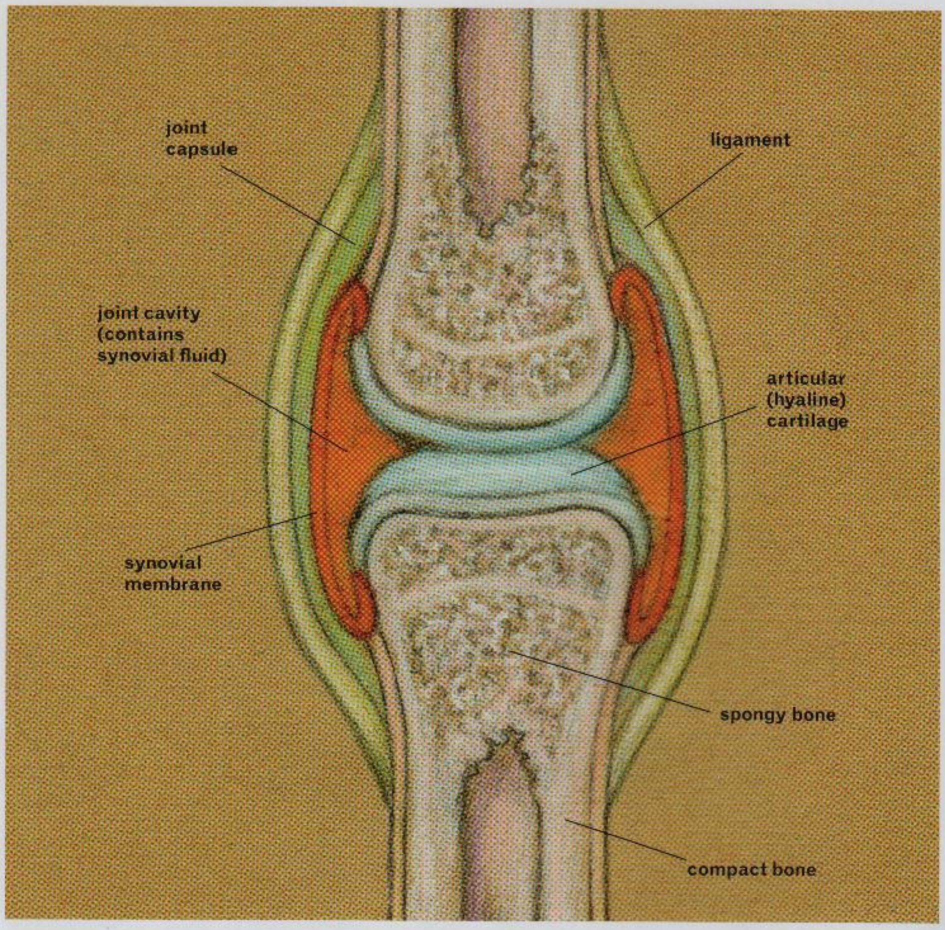
MOVEMENT	MEANING	ORIGIN OF TERM
Synchondrosis Joint (sin-kon-DROH-siss) Synonyms: primary cartilaginous joint, synchondrodial joint	Provides stability; immovable. Example: joint at first costal cartilage (of rib) and sternum.	Greek *syn* = together + *chondros* = cartilage + *osis* = condition
Symphysis Joint (SIM-fih-siss) Synonym: secondary cartilaginous joint	Occurs on medial line of body; slightly movable. Examples: intervertebral joints of the spinal column, pubic symphysis of pelvis.	Greek *symphysis* = a growing together

Synovial Joints

Synovial joints are enclosed within a *joint capsule* of fibrous connective tissue that helps strengthen and protect the joint. The inner layer of the joint capsule is lined with a *synovial membrane,* which produces the *synovial fluid* that lubricates the joint. Overlying the capsule are connecting ligaments, which bind, reinforce, and stabilize the joint.

Synovial joints are classified according their surface shapes and the degree of movement permitted in the joint area. Some joints provide a greater range of mobility, while others are more stable.

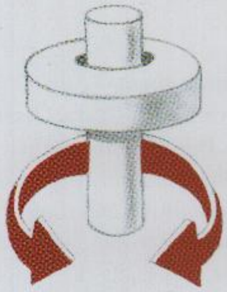
Synovial joints include the following types: *ball-and-socket joints, ellipsoid/condyloid joints, gliding/plane joints, hinge joints, pivot joints,* and *saddle joints.*

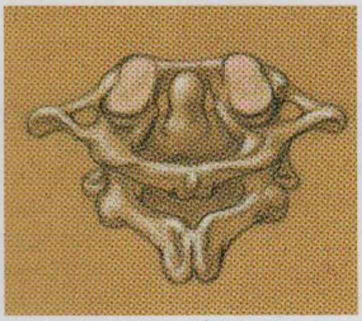


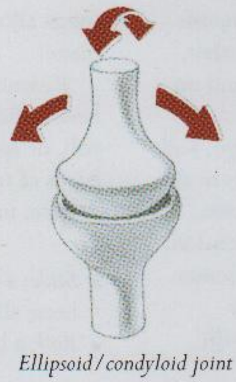
SYNOVIAL JOINT CAPSULE (GENERALIZED STRUCTURE)

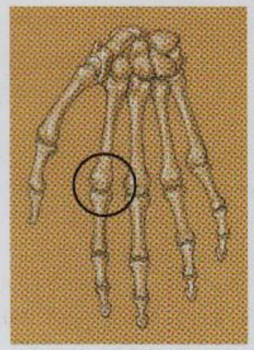
Synovial Joints

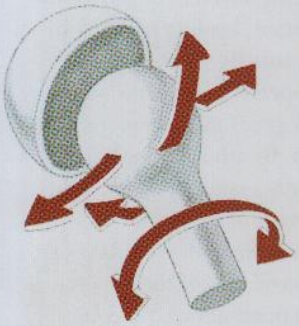
TYPE OF JOINT	DESCRIPTION/MOVEMENT	EXAMPLES
Ball-and-Socket Joint Synonyms: articulatio spheroidea (TA), spheroid joint, enarthrosis, enarthrodial joint, cotyloid joint	Ball-shaped head of one bone fits into cuplike socket of another bone. Multiaxial movement: flexion and extension, abduction and adduction, rotational movement, circumduction.	Shoulder joint (gleno-humeral joint: glenoid fossa of scapula and humerus); hip joint (head of femur and acetabulum of pelvis)
Ellipsoid/Condyloid Joint Pronunciation: ee-LIP-soyd/ KON-dih-loyd Synonyms: ellipsoid joint: articulatio ellipsoidea (TA); condyloid joint: condylar joint	Oval-shaped end of one bone fits into oval-shaped cavity of another bone. Biaxial movement: flexion and extension, abduction and adduction.	Finger joints (metacarpo-phalangeal joints); wrist joint (radio-carpal joint); neck joint (atlas vertebra and cranium: atlanto-occipital joint)
Gliding/Plane Joint Synonyms: articulatio plana (TA), arthrodia, arthrodial joint	Two bones with slightly flattened surfaces glide across each other. Uniaxial movement (limited, side-to-side movement).	Wrist bones (inter-carpal joints); foot bones (inter-tarsal and sub-talar joints)
Hinge Joint Synonyms: ginglymus (TA), ginglymoid joint	Convex surface of one bone fits into concave surface of another bone. Uniaxial movement: flexion and extension.	Elbow joint (humero-ulnar joint); knee joint (tibio-femoral joint); finger joints (inter-phalangeal joints); toe joints (inter-phalangeal joints); ankle joint (talo-crucal joint); jaw joint (temporo-mandibular joint, or TMJ)
Pivot Joint Synonyms: articulatio trochoidea (TA), swivel joint, rotary joint, rotatory joint, trochoid joint	Rounded end of one bone rotates within ringlike structure formed by another bone and ligament. Uniaxial movement: rotation.	Neck joint (atlas and axis vertebrae: atlanto-axial joint); elbow joint (radius and ulna: radio-ulnar joint/proximal)
Saddle Joint Synonyms: articulatio sellaris (TA), sellar joint, reciprocal reception	Two ends of bones shaped somewhat like saddles, with convex and concave surfaces. Biaxial movement: flexion and extension, abduction and adduction. (Some experts consider the saddle joint to have triaxial capability: circumduction.)	Base-of-thumb joint (carpo-metacarpal joint of thumb)

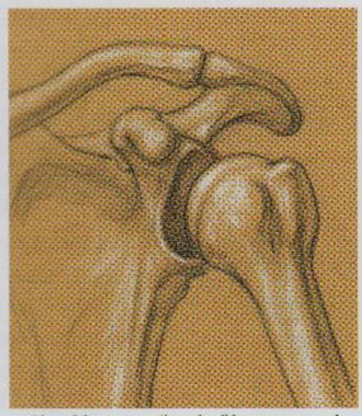

Pivot joint

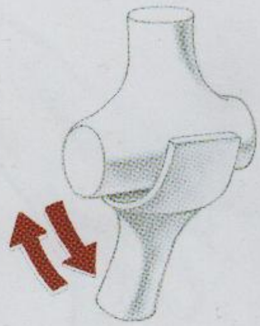

Neck joint at base of cranium (atlas and axis cervical vertebrae)

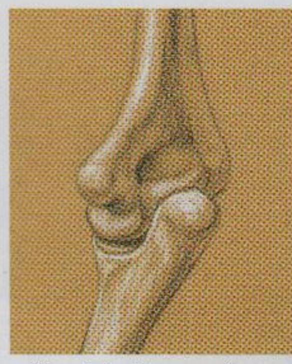

Ellipsoid/condyloid joint

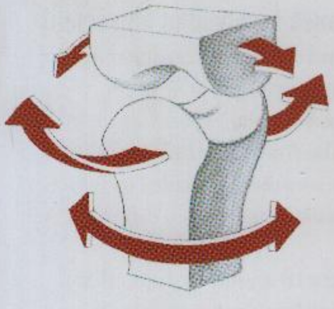

Finger joint (MCP joint)

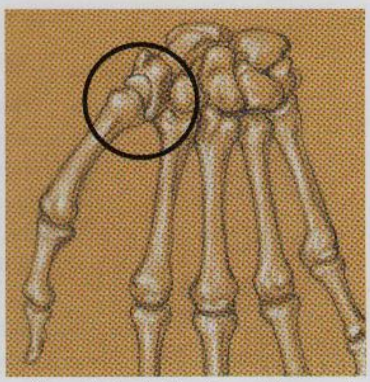

Ball-and-socket joint

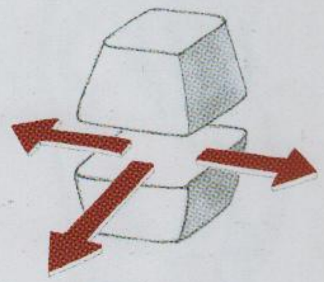

Shoulder joint (head of humerus and glenoid fossa of scapula)


Hinge joint


Elbow joint (humerus of upper arm and ulna of lower arm)


Saddle joint


Base-of-thumb joint (carpal bone and metacarpal bone)


Gliding/plane joint


Tarsal bones of foot

TYPES OF SYNOVIAL JOINTS

Synovial Joints

PRONOUNCIATION

sih-NO-vee-ul

ORIGIN OF THE TERM

Greek *syn* = together + Latin *ovum* = egg

SYNONYMS

articulatio (TA), diarthrosis (TA), junctura synovialis (TA), diarthrodial joint, freely movable joint, movable joint

LIGAMENTS AND JOINTS

Ligaments connect bones to other bones and help keep joints in position so that they do not become "out of joint." These fibers, which have minimal flexibility, can only stretch about 6 percent longer than their normal length before they are at risk of being torn. When people have an unusually high degree of elasticity in their joints, they are often called "double jointed." In reality, these people do not have twice as many joints as other people—just unusually flexible ligaments and joint capsules.

Movement at Synovial Joints

The kind or kinds of movement possible at a synovial joint depend on the shapes of the articulating bones forming the joint, the type of joint involved, the ligaments binding the articulating bones together, and the muscle attachments near and on the joint.

Because of their particular design, ball-and-socket joints allow movements in all the anatomical planes: circumduction, abduction, adduction, flexion, extension, and rotation. Ellipsoid/condyloid joints and saddle joints allow movements (abduction and adduction, along with flexion and extension) in two planes. Hinge joints allow movements (flexion and extension) in only one plane. Pivot joints allow rotational movements on one plane.

Researchers studying joint movements have indicated that joint surfaces can slide, roll, or spin. A combination of these three types of motion can be found, to some degree, in all synovial-joint movements:

- *Slide*: a gliding movement in which one bone slides over another bone
- *Roll*: a bending movement, essential to flexion and extension, that occurs as one bone rolls over another bone
- *Spin*: a bone pivoting in a movement of rotation

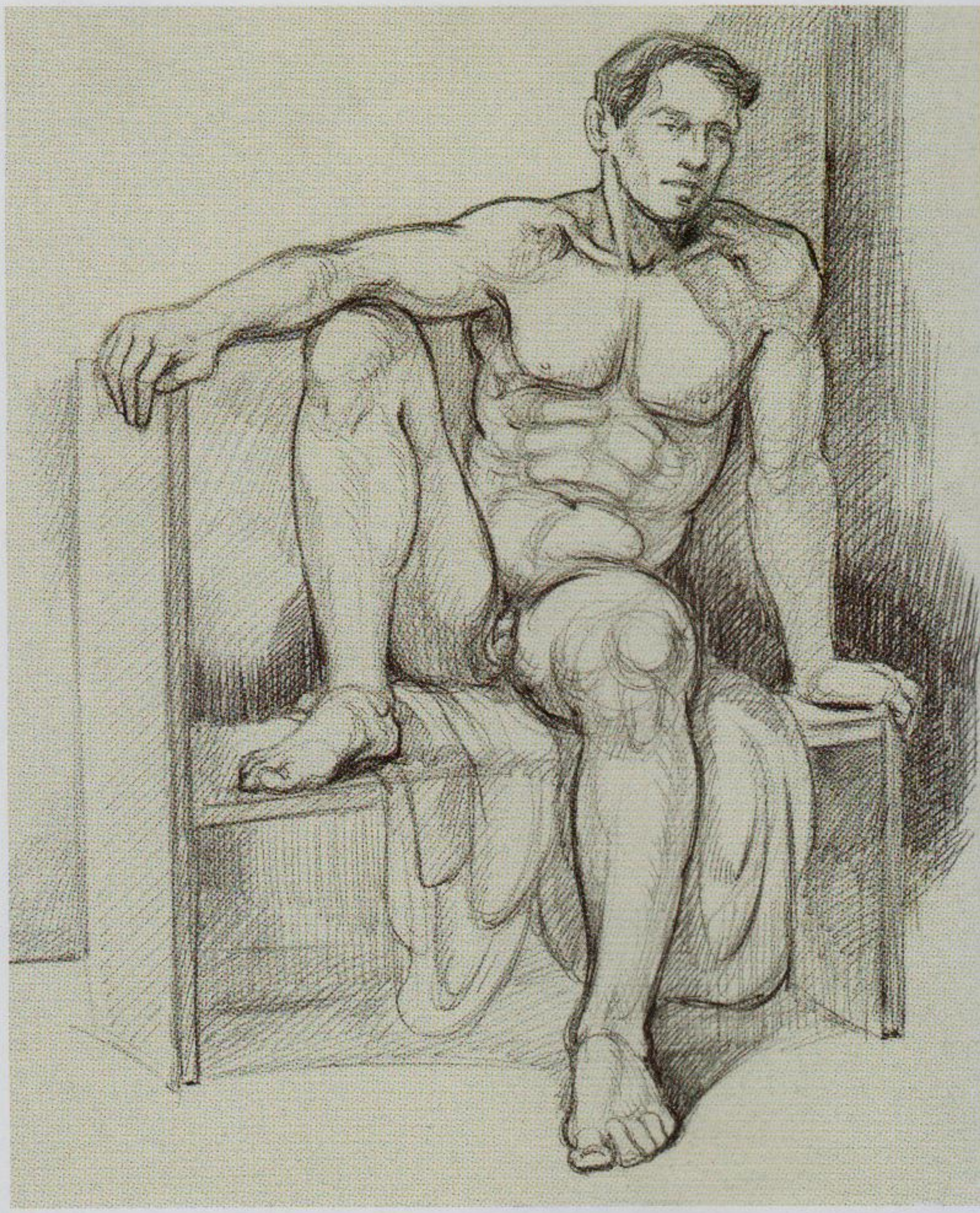
ACTION POSE, BACK

Joints' degree of movement—called range of motion, or ROM—varies from person to person. People differ in their movement capability for many reasons, including muscle condition and tone, the flexibility of connective tissues, and the condition of bones, especially the joints. Dancers and athletes have much greater flexibility in their joint movements than do inactive people. As people age, their joints suffer from extensive wear and tear, and the articulating surfaces of the joints begin to deteriorate, leading to a loss of flexibility that limits ROM. As a result, it is difficult to specify an exact formula for measuring degrees of movement in human beings. By studying various actual movements—walking, running, jumping—by freeze-framing the action, artists can gain a basic understanding of how the joints move and of the general range of motion possibilities. Drawing the figure in many different action poses also contributes to the understanding of movement.

Number of Planes Involved in Movement

Some joints (and the bones associated with them) can move only in a single plane, others in two planes, and some in three planes. The following terms are used to describe the number of planes in which a joint and its associated bones can move:

- *Uniaxial* refers to a joint or bone that can move in only one plane (as, for example, in the flexion and extension of the elbow joint [humero-ulnar joint], involving the humerus and ulna bones).
- *Biaxial* refers to a joint or bone that can move in two planes (as, for example, in the flexion/extension and abduction/adduction of a finger at the knuckle joint [the metacarpo-phalangeal, or MCP, joint]).
- *Triaxial* or *multiaxial* refers to a joint or bone that can move in three planes (as, for example, in the circumduction of the whole arm, which involves the ball-and-socket joint at the head of the humerus and the glenoid fossa of the scapula [the gleno-humeral joint]).



MALE SITTING ON BENCH

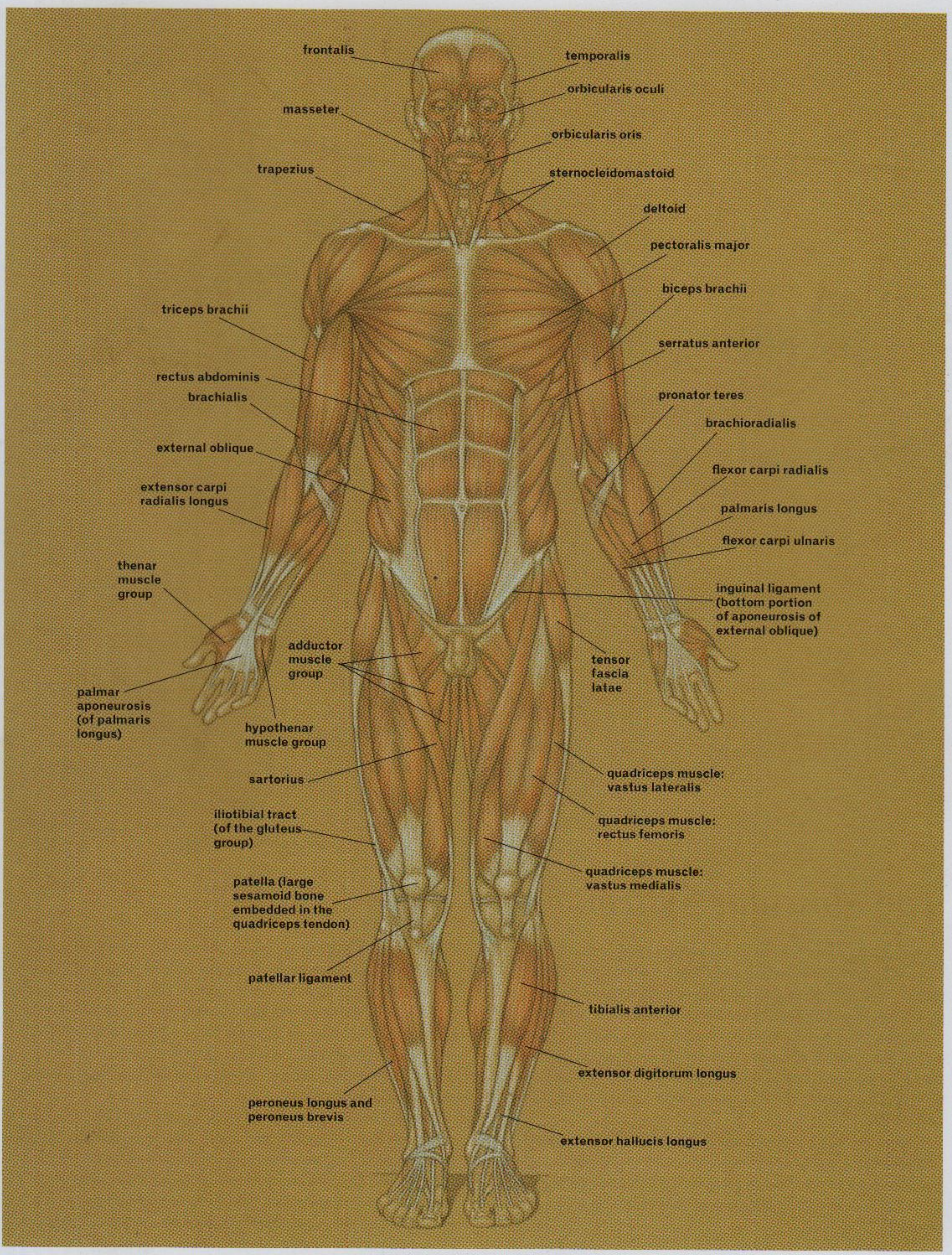
The Muscular System

The muscular system, in all its beauty and complexity, has always been an inspiration as well as a challenge for artists depicting the human figure. Muscles give the human body its form, definition, and dynamism. Attached by tendons to hundreds of sites throughout the skeletal system, muscles create multiple layers of overlapping muscular forms. They are responsible for producing movements as intricate as those of playing a violin and as powerful as that of catapulting the body through the air to slam-dunk a basketball.

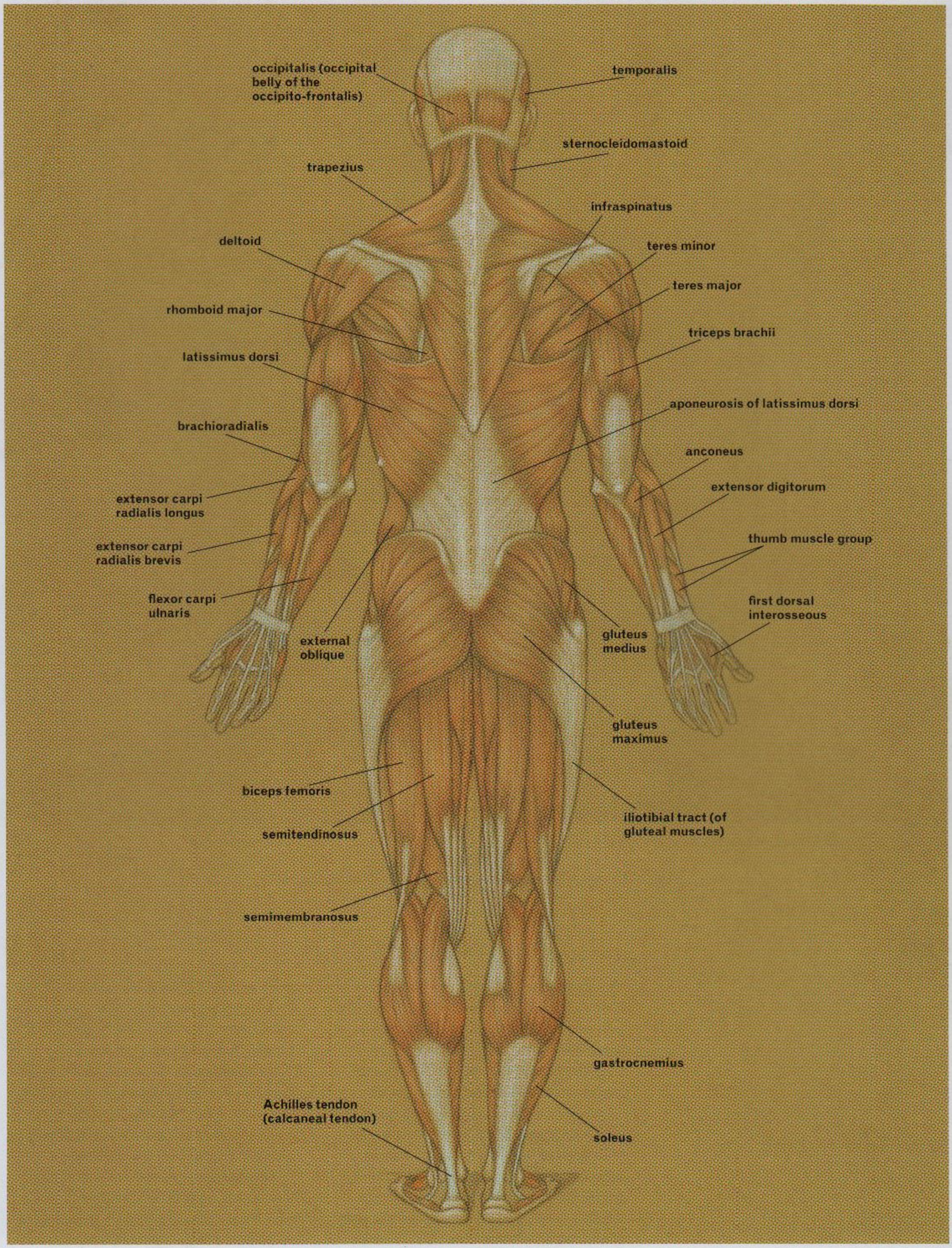
Our word *muscle* comes from the Latin *musculus,* meaning "little mouse." Apparently, anatomists of ancient times thought that the shape of a muscle rippling beneath the skin during movement looked like a little mouse moving under a piece of cloth.

The human body has nearly seven hundred individual muscles (although anatomists have disputed the exact number for decades), each with its own name, but artists need to concern themselves only with the muscles that influence surface forms or contribute significantly to movement. There are three types of muscles in the body: smooth muscles, cardiac muscles, and skeletal muscles. Artistic anatomy focuses primarily on skeletal muscles. These muscles, which, as their name indicates, attach directly to the skeleton, are the ones that influence the shape of the surface form.

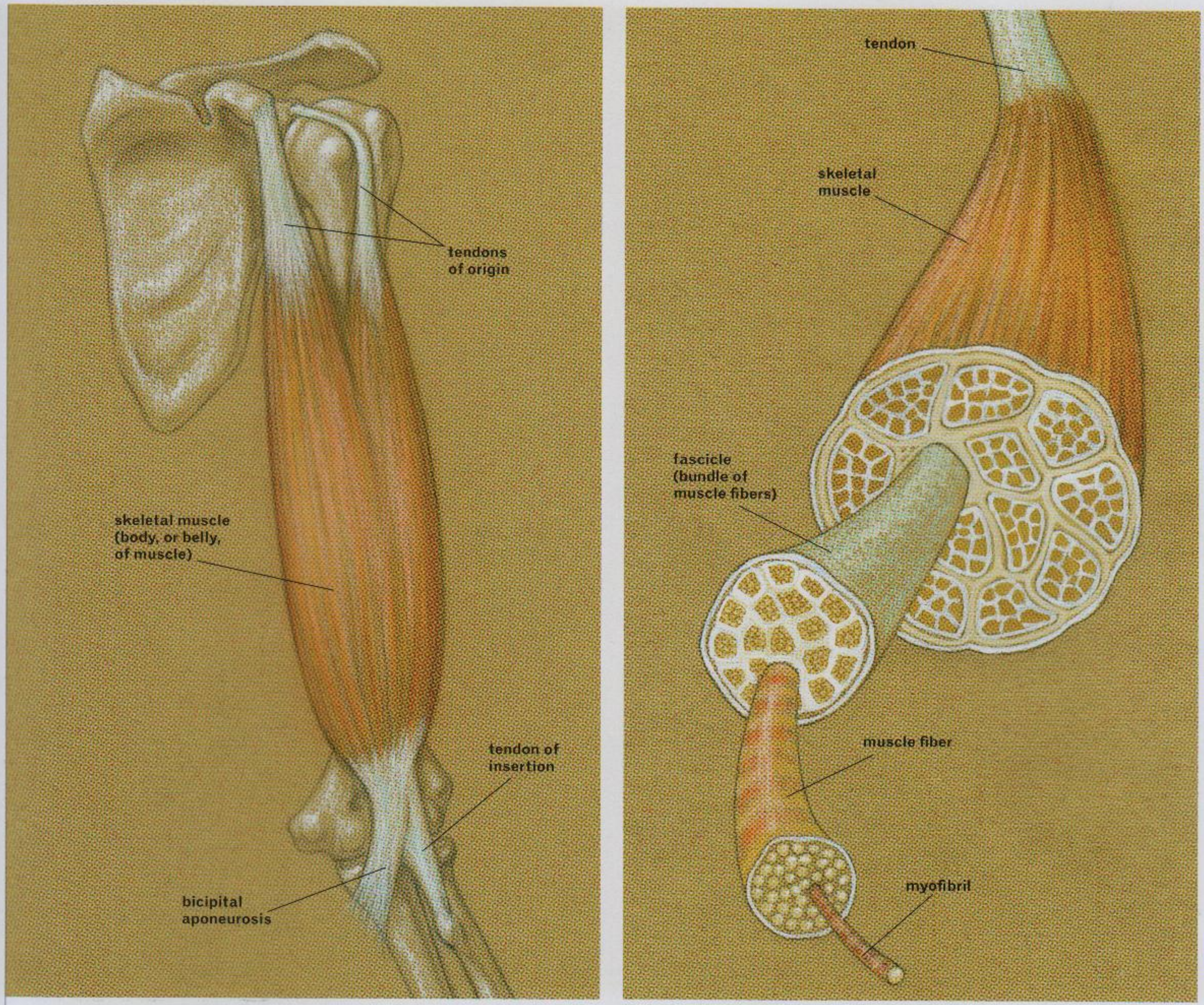
Skeletal muscles come in all shapes and sizes—long and short, thick and thin, large and small. Moreover, muscles change their shapes during movement, depending on the kind of action taking place. They are engaged in a constant, alternating cycle of stretching and compression. When a muscle contracts, its shape generally becomes more clearly defined on the surface, appearing more compact. In its relaxed state, a muscle is usually softer in appearance and less well defined on the surface form.



MUSCULAR SYSTEM (ANTERIOR VIEW)



MUSCULAR SYSTEM (POSTERIOR VIEW)



External structure (biceps brachii muscle of left arm) *Internal structure*

MUSCLE STRUCTURE

Basic components of external and internal structure of a skeletal muscle.

The Structure of Muscles

The main external form of a skeletal muscle is called the *belly,* or *body.* The area where the belly of the muscle narrows toward the tendon of origin is referred to as the *head* of the muscle. The overall muscle structure is encased with thin connective tissues that merge to form the *tendons,* which are usually located at both ends of the muscle. The tendons function like cables, linking a muscle to a bone or another structure. The area where a tendon attaches is called the *point of attachment,* or *attachment site.* Tendons come in a variety of shapes: Some are thick, cordlike structures that are easy to see on the surface form when the muscle is under tension during contraction. Other tendons are flattened bands and are therefore harder to detect on the surface. The wide, sheet-like tendons called aponeuroses attach the muscle to bones or other structures over a broad area.

The internal structure of a skeletal muscle is composed of elongated, cylindrical cells called *muscle fibers,* which are gathered in groups called *bundles,* or *fascicles.* These bundles are held together by connective tissue. Within each individual muscle fiber are elongated, rodlike strands called *myofibrils,* that run parallel to each other and extend the entire length of the muscle fiber. Myofibrils are composed of microscopic threads of thick and thin contractile proteins called *myofilaments.*

The main function of skeletal muscles is to produce movement, which occurs when the fibers contract, pulling on the bone to which the muscle is attached and causing it to move.

Muscle Names

Since there are many hundreds of muscles in the human body, anatomists have faced quite a challenge in identifying each one separately and avoiding confusing terminology. Characteristics such as muscles' shapes, sizes, and locations have influenced the names given to them, as have their functions in producing certain kinds of action. Terms indicating the direction of the muscle fibers, the number of heads a muscle has, and its position in relation to the planes of the body (that is, directional terms) have been added to certain muscles' names to identify them even more completely. And some muscle names combine information about their attachments, size, and functions: For example, the name *extensor carpi radialis longus* means the *long* muscle pertaining to the *radius* bone of the forearm that *extends* the *wrist* of the hand.

The following list summarizes the many different kinds of terms that may appear in a muscle's name:

- *Muscle fiber direction*: Terms indicating the direction of the muscle fibers in relation to the medial line of the body. Examples: *rectus* abdominis, external *oblique.*
- *Muscle action or function*: Terms indicating the primary action or function of the muscle. Examples: *adductor* longus, *extensor* carpi ulnaris, *flexor* pollicis brevis.
- *Muscle size*: Terms indicating the relative size or length of a muscle. Examples: pectoralis *major,* gluteus *maximus,* extensor carpi radialis *longus.*
- *Muscle shape*: Terms referring to familiar shapes that the muscle resembles. Examples: *trapezius, orbicularis* oris, *deltoid.*
- *Number of muscle attachments (heads)*: Terms indicating the number of heads or tendons of origin a muscle possesses. Examples: *biceps* brachii, *triceps* brachii, *quadriceps.*
- *Muscle attachment sites*: Terms indicating the sites of origin and insertion attachments. Examples: *sternocleidomastoid, brachioradialis.*
- *Muscle location*: Terms referring to a bone or body region where the muscle is located. Examples: biceps *femoris,* biceps *brachii,* rectus *abdominis.*
- *Muscle directional terms*: Terms indicating the muscle's position in relation to the planes of the body. Examples: vastus *lateralis,* tibialis *anterior,* latissimus *dorsi.*

Muscle Attachments—Origins and Insertions

The primary function of a skeletal muscle is to contract—that is, to shorten its muscle fibers. The function of a fibrous tendon is to attach a muscle to a bone. Skeletal muscles and their tendons usually attach on two separate bones—and sometimes more if a muscle has multiple tendons. In some cases, muscle tendons will attach on other structures.

The *origin* of the muscle is usually on a fixed bone, which does not move when the muscle contracts, whereas the *insertion* of the muscle is attached on a bone that does move when the muscle contracts. As a general rule, the bone with the insertion attachment of the contracting muscle moves toward the bone that has the origin attachment. In medical charts and on skeletons, origin sites are standardly indicated in red and insertion sites in blue.

Muscle Attachments

Origin
Synonyms: punctum fixum (TA), tendon of origin, proximal attachment, fixed part of the skeleton, stationary point of attachment, fixed end

Insertion
Synonyms: punctum mobile (TA), tendon of insertion, distal insertion, more movable point of attachment, more movable part of the skeleton, mobile end

Types of Muscle Fibers

The arrangement of muscle fibers varies considerably among muscles and can affect the muscles' ability to produce movement or generate power. The muscle-fiber direction types are *parallel, pennate, circular,* and *convergent*. Some muscle fibers, such as the elongated parallel fibers, allow for greater movement but do not have much power or strength. The shorter pennate fibers have more power and strength in their contractions but produce a limited range of motion.

PARALLEL MUSCLE FIBERS

Parallel muscle fibers follow the long axis of the muscle. These long fibers allow a greater range of motion (ROM). When parallel muscles contract, they can shorten by up to 50 percent of their length when they are relaxed.

There are two kinds of muscles with parallel fibers: *fusiform* and *straplike*. The fibers of the fusiform type run parallel to each other but bulge at their centers and taper toward each end. Examples include the biceps brachii of the upper arm and the semimembranosus of the hamstring group of the upper leg.

The fibers of the straplike type are usually long and slender (like a strap), but some muscles of this type (such as the masseter muscle of the jaw) can be shorter. Examples of parallel straplike muscles include the sternocleidomastoid of the neck, the sartorius of the upper leg, and the rectus abdominis of the torso.

PENNATE MUSCLE FIBERS

Pennate muscles have shorter fibers that are arranged at an oblique angle to the tendon. The tendons are usually very long in the pennate muscles. Structurally, the fibers of this type of muscle resemble the vanes of bird feathers.

There are three types of pennate-fibered muscles: *unipennate, bipennate,* and *multipennate*. In a unipennate muscle, the fibers are attached at an oblique angle along one side of the tendon. An example is the semitendinosus of the hamstring group of the upper leg.

In a bipennate muscle, the fibers are attached at oblique angles along both sides of the tendon. Examples include the rectus femoris of the quadriceps group of the upper leg and the dorsal interosseous muscles of the metacarpal bones of the hand.

A multipennate muscle has multiple tendon branches with muscle fibers attached along on both sides of each tendon. These muscles have the appearance of interwoven braids or of several feathers laid side by side. Multipennate muscles are much more developed in athletic bodies. Examples include the deltoid muscle of the shoulder.

CONVERGENT MUSCLE FIBERS

A muscle with convergent fibers has a broad origin and tapers (converges) toward a single tendon of insertion. Such muscles often resemble large, open fans and are triangular in shape. Examples include the temporalis of the cranium and the pectoralis major of the chest.

CIRCULAR MUSCLE FIBERS

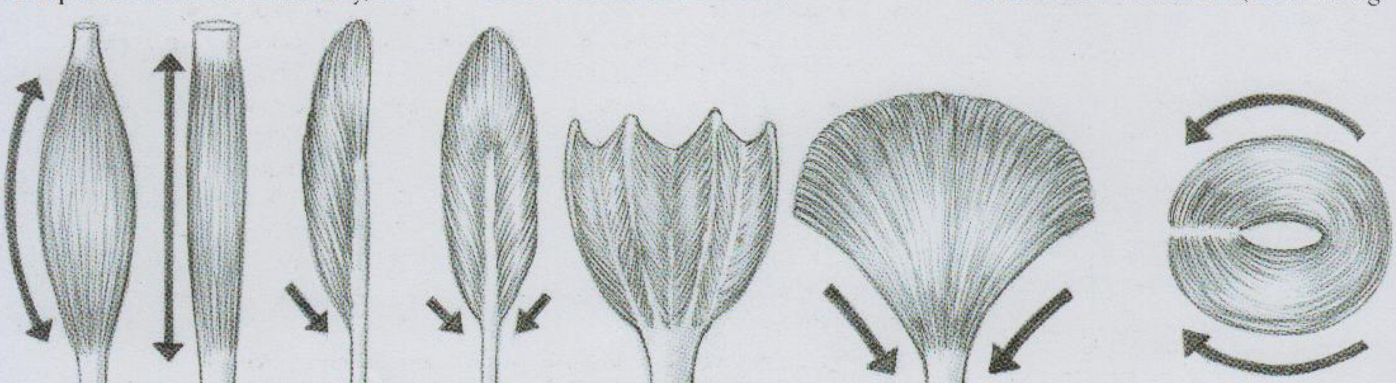
In circular muscles, the fibers are arranged in concentric rings. They surround an opening or orifice, which they close by contracting. Examples include the orbicularis occuli of the eye and the orbicularis oris of the mouth.

How Skeletal Muscles Create Movement

To create movement, skeletal muscles usually work together in pairs or opposing groups. Muscles perform different roles, depending on what kind of movement is required at any given moment. They can act as *agonist muscles, antagonist muscles, synergist muscles,* or *stabilizer muscles* and can instantly change roles with each different movement.

The muscle responsible for the primary movement of a body part or bone is called the agonist (or *prime mover* or *primary muscle*). When the agonist contracts, shortening its fibers, other muscles (usually in opposition to the agonist) stretch or relax to accommodate the movement of the bone. These muscles, which counteract the agonist muscles, are called antagonist muscles. When the body part or bone is moved back to its original position, this action is performed by the antagonist muscles. As they contract, bringing the bone back to its initial position, the original agonists stretch or elongate to allow the repositioning of the body part or bone to be completed.

In other words, as the movement reverses, the original agonist and antagonist muscles reverse roles. An example may help clarify: In the flexing of the elbow to bend the lower arm upward toward the upper arm, the biceps brachii, positioned on the anterior (front) part of the humerus bone, is the agonist, and the triceps brachii, positioned on the posterior (back) of the humerus, is the antagonist. When the biceps contracts its fibers, it lifts up the lower arm, while the triceps slightly elongates or stretches out. In the reverse movement (the lowering



Parallel fibers: fusiform *Parallel fibers: straplike* *Pennate fibers: unipennate* *Pennate fibers: bipennate* *Pennate fibers: multipennate* *Convergent fibers* *Circular fibers*

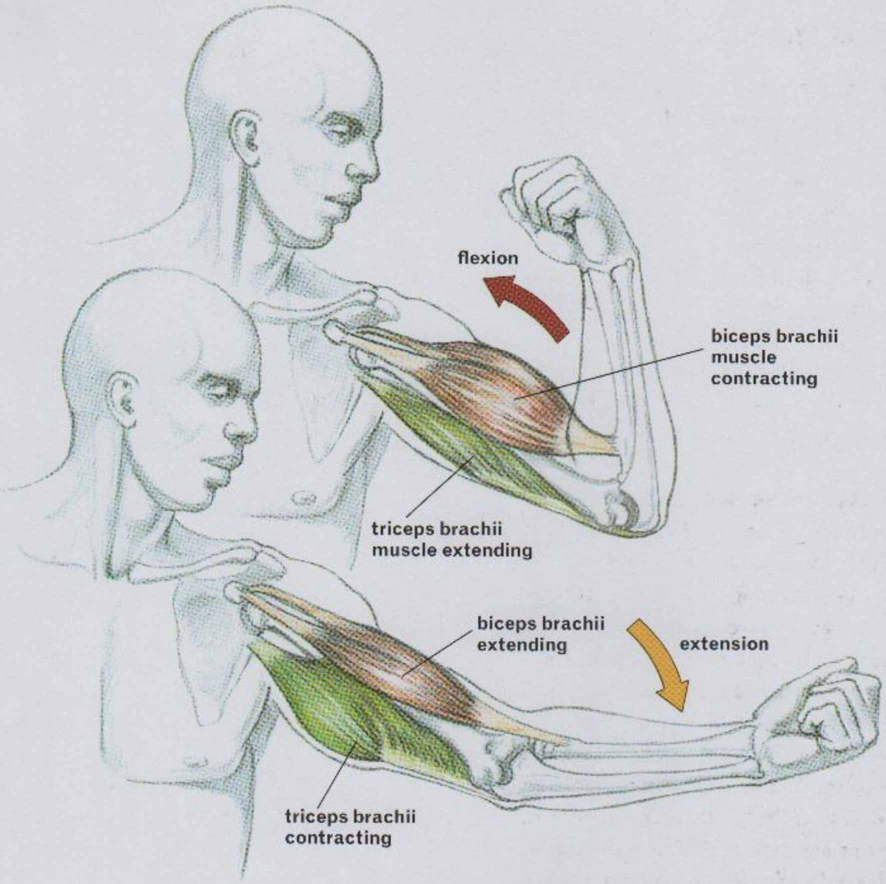
MUSCLE FIBERS—TYPES

of the forearm), the triceps becomes the agonist, contracting its muscle fibers to pull the lower arm downward while the biceps (now in the antagonist role) elongates and stretches. The entire movement is performed by pulling actions of the contracting muscles. Muscles never "push" a bone in a movement.

Artists commonly refer to the movement of agonists and antagonists as "squash and stretch" or "compress and stretch." They look for it in various poses, but it is especially noticeable in action poses. When the agonist (prime mover) contracts its muscle fibers, the surface form becomes compressed, sometimes creating a rich, bulbous shape. When the antagonist muscle lengthens or relaxes, the surface form pulls taut. You should observe these differences, because they help you see the dynamic action occurring in the surface forms.

Actions, however, are not produced solely by the interaction of agonist and antagonist muscles. Actually, several other muscles participate in the movements of the bones. These other muscles are referred to as synergists (or *assistors* or *secondary muscles*) because they assist the primary agonist muscle during its movement.

Yet other muscles, called *stabilizers* or *fixators*, provide stationary support to help hold a joint or bone in place during the movement of another bone. For example, there are muscles that help stabilize the scapula bone to prevent it from moving while the humerus is being moved by agonist muscles.



CREATION OF MOVEMENT BY SKELETAL MUSCLES

In the transaction of any movement, an incredible amount of coordination occurs among muscles and muscle groups. These muscular interactions have a precision and a flowing quality that are particularly noticeable in the dynamic movements of athletes and dancers but are evident even in ordinary day-to-day movements such as walking or putting on a garment.

As the body moves through a series of actions, there are rhythmic changes in the timing of the moves being executed. These "tempo changes"—as when a slow rotation of a head is followed by a fast swing of an arm—contribute to the dynamics of action poses, and observing them is essential for artists who work with the animated figure.

Parallel Muscle Fibers

SYNONYMS
musculus rectus (TA), straight muscle

Pennate Muscle Fibers

PRONOUNCIATION
PEN-ate

ORIGIN OF THE TERM
Latin *penna* = feather

SYNONYMS
musculus pennatus (TA), penniform

Convergent Muscle Fibers

SYNONYMS
musculus triangularis (TA), radiated muscle, triangular muscle

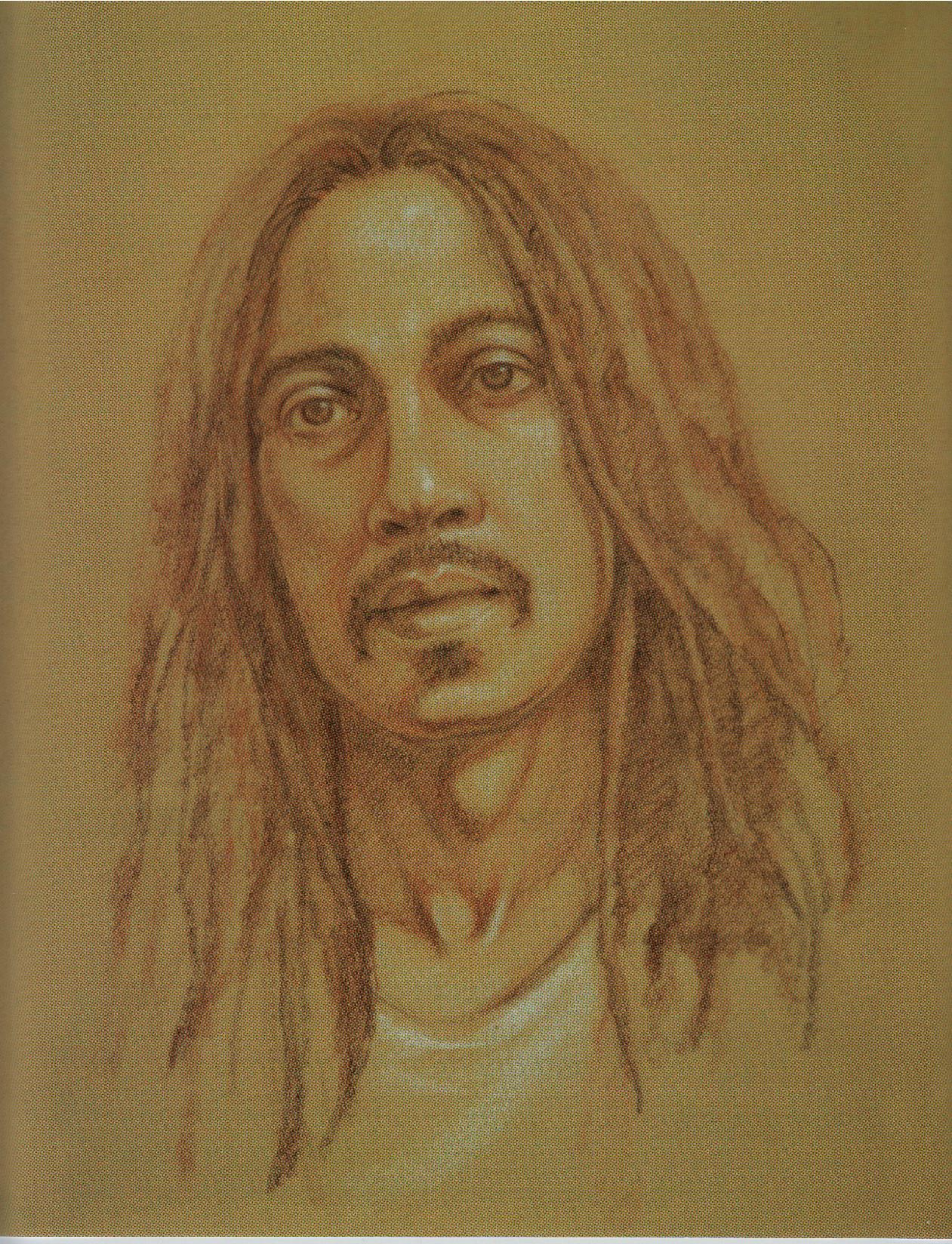
Circular Muscle Fibers

SYNONYMS
musculus orbicularis (TA), orbicular muscle

Examples of Paired Muscles and Muscle Groups

Note that roles of agonists and antagonists reverse when the movement or action is reversed.

AGONIST (AND LOCATION)	ANTAGONIST (AND LOCATION)
Biceps brachii with brachialis and brachioradialis (anterior side of upper arm)	Triceps brachii with anconeus (posterior side of upper arm)
Flexor group of forearm (anterior side [palm side] of lower arm)	Extensor group of forearm (posterior side [back-of-hand side] of lower arm)
Left side of external oblique with internal oblique and sacrospinalis on left side (left side of torso)	Right side of external oblique with internal oblique and sacrospinalis on right side (right side of torso)
Rectus abdominis (abdomen)	Sacrospinalis (spinal column)
Gluteus medius with gluteus minimus and tensor fascia latae	Adductor group: adductor longus, adductor brevis, and adductor magnus (inner thigh)
Quadriceps group: vastus lateralis, vastus medialis, vastus intermedius, rectus femoris (front of upper leg)	Hamstring group: biceps femoris, semitendinosus, semimembranosus (back of upper leg)
Gastrocnemius with soleus (back of lower leg)	Tibialis anterior (front of lower leg)



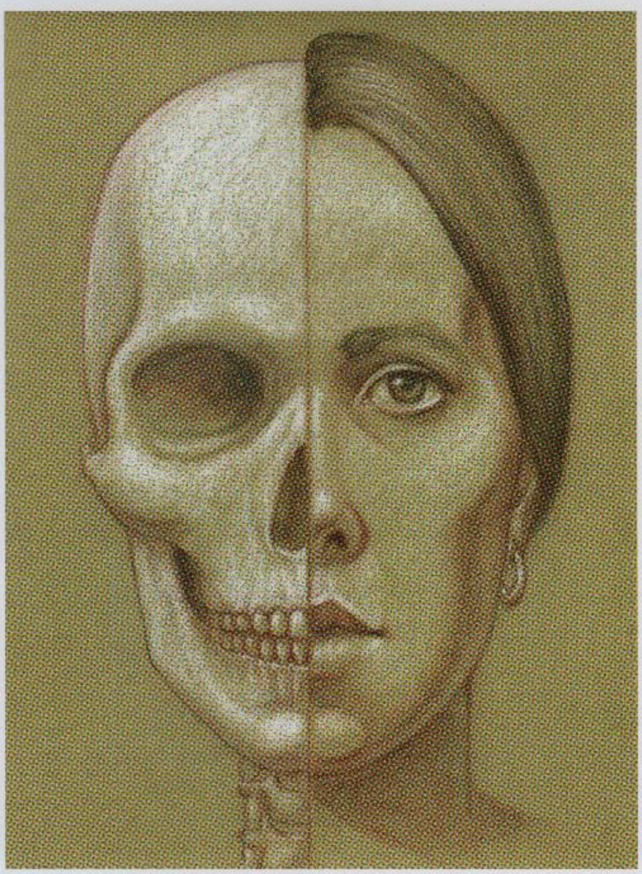
Chapter 2 The Head, Face, and Neck

The human face is one of the most challenging forms to portray. Whether drawn, painted, sculpted, or created digitally, the head and facial features continue to intrigue and inspire us with their poetic, mysterious beauty. The differing portrayals of the face in art over the centuries allow us to observe the many ways the face has been interpreted. From the noble, beautifully carved heads of pharaohs in monumental ancient Egyptian statuary to the delicate renderings of women's faces in eighteenth-century Japanese Ukiyo-e woodblock prints, we sense the dynamic variations in how artists have observed and represented the human face.

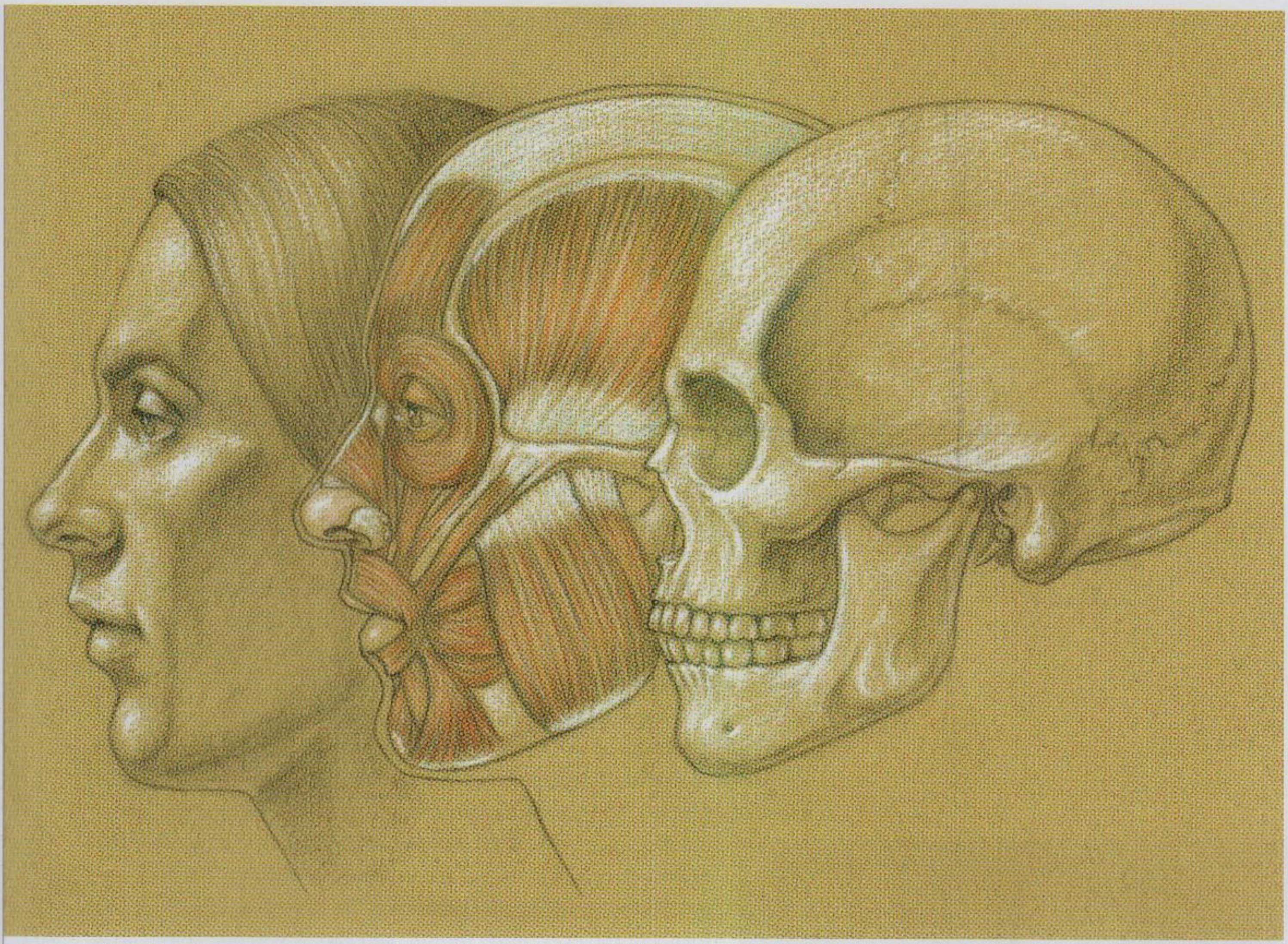
By learning the anatomy of the human head, an artist can systematically figure out the forms he or she observes when portraying an individual person. An awareness of the head's basic planes can be extremely beneficial in helping the artist comprehend the complexities of facial structure. Studying the basic components of the skull can give artists a better understanding of how the muscle tissues are anchored to the bones and other structures. Studying and practicing the facial features—the basic forms of the eyes, nose, mouth, and ears—will enable the artist to capture the face with more confidence and greater ease.

The anatomical approach—an *analytical* approach to understanding the head—works well when balanced with an *intuitive* approach that emphasizes the face's expressive nature. Being able to suggest the character of the person being portrayed or to convey the individual's psychology or "inner essence" is every bit as important as knowing the basic anatomical structures and mechanisms.

Although this book focuses primarily on an anatomical, analytical approach to the human figure, I strongly urge you to explore various styles and techniques of portraiture. Those skills, along with your study of facial anatomy, will give your work a deeper personality—one that is truly unique to you. Still, an anatomical understanding of the head will equip you with the key fundamentals that will eventually pave the way to a more creative and expressive interpretation of the face.



Above: **SKELETAL PORTRAIT**
Opposite: **PORTRAIT OF OTEINO**



ANATOMICAL HEAD STUDIES

The Skull

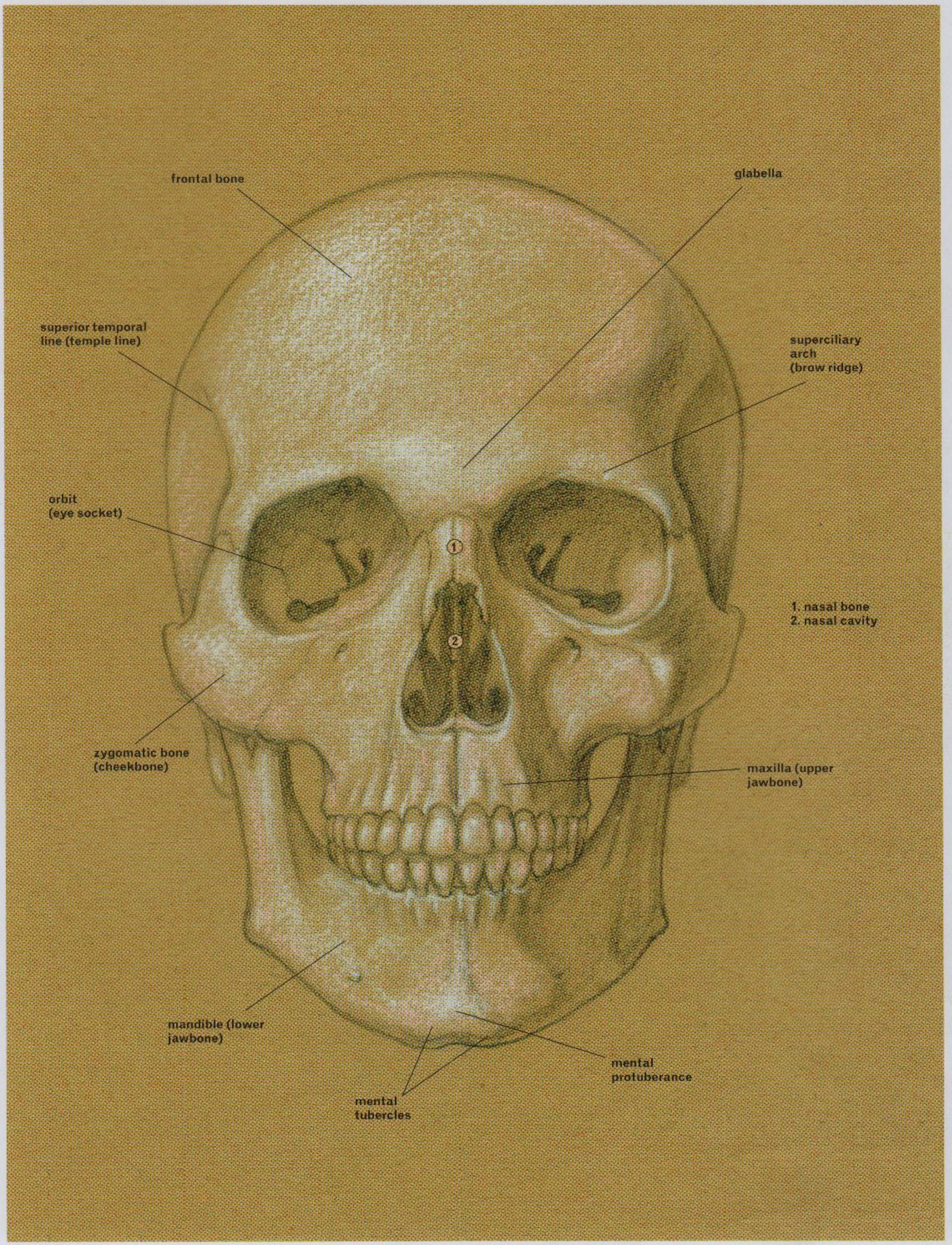
For centuries, artists have been captivated by the skull, not only because of its hauntingly beautiful structure but also because of its symbolism and the powerful meaning it conveys. In ancient times, many cultures associated the skull with power and wisdom and believed that skulls were infused with spirit and energy. Ancestral skulls were greatly honored. In many traditions, the skulls of slain enemies were decorated and preserved as proud trophies.

Alchemists used the image of the skull, positioned above two crossed elongated bones, as a warning that a vessel contained a poisonous substance. Variations of this skull-and-crossbones motif were adopted by pirates in the late 1600s as an emblem of terror, and the image is still used today as a warning of toxicity.

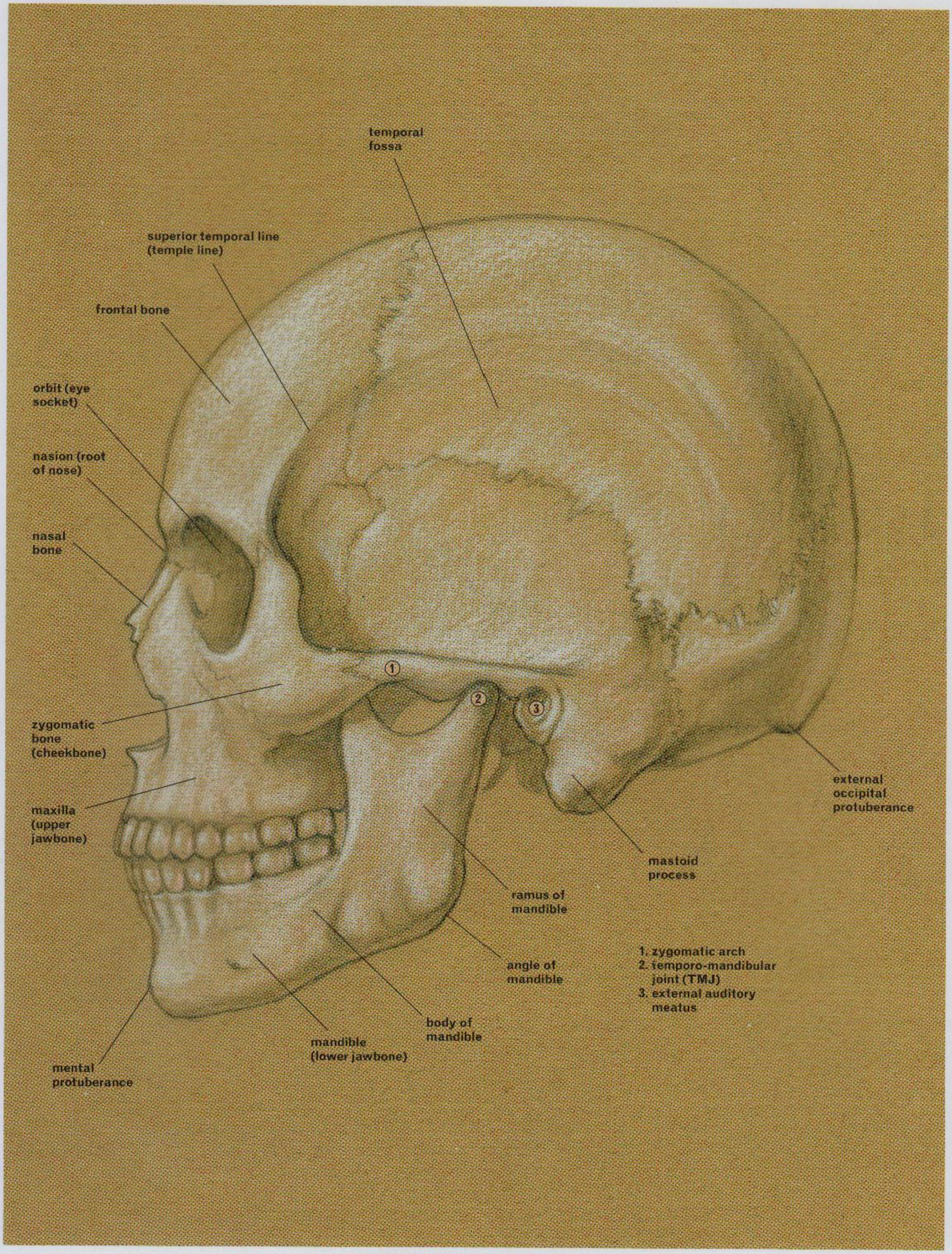
During medieval times, as the great plagues swept across Europe, the skull became a representation of death. In Christian mysticism, the skull served as a symbol of mortality—a reminder of death (*memento mori*) used by saints and monks as an aid in meditation. And in many Renaissance paintings a skull appears as a reminder of the transience of human life and the vanity of attachment to earthly possessions.

In artistic anatomy, the skull is the foundation for the muscles of the head and the features of the face. The skull is a very complex, bony structure composed of twenty-two bones, excluding the teeth and the ossicles of the ears (the miniscule bones of the inner ear that assist in hearing). With the exception of the mandible (lower jawbone), the bones of the skull are connected by immovable joints.

Numerous variations in the bony structures of the skull give each person's face its particular individuality. Muscles and other soft tissues do contribute to the character of an individual's face, but the skull provides the structural basis for the person's facial uniqueness. Some people have broad, steep foreheads (frontal bones), while others' foreheads have a more gentle slope. In some people, the cheekbones (zygomatic bones) are quite obvious; in others, these bones are not as prominent on the surface form. Jawbones can range from hefty and squarish to delicate and refined. On some people's faces, the edge of the nasal bone produces an obvious bump on the nose; on others' faces, there is a smooth transition from the nasal bone to the cartilage with no bump whatsoever. Understanding these bony landmarks, as well as the muscles and soft tissues of the face, will greatly enhance your ability to capture the facial structure and general character of an individual person.



CRANIUM—ANTERIOR (FRONT) VIEW



CRANIUM—LATERAL (PROFILE) VIEW

The Bones of the Skull

The bones of the skull are divided into two main groups: the bones of the cranium and the bones of the face (facial bones). The individual bones within each group are identified in the figures at the top of page 74.

The Bones of the Cranium

Eight bones make up the cranium section of the skull. Together, these bones form a protective encasement for the brain. The cranium consists of two portions: the *cranial vault,* which forms a domelike roof over the top and sides of the brain, and the *cranium floor* (or *cranium base*), which securely positions the brain.

The walls on either side of the skull are composed of two sets of paired bones: the *parietal bones,* which form the upper sides and most of the cranial roof, and the *temporal bones,* which form the lower outer walls of the skull as well as a portion of the cranium floor. From each temporal bone, a bony bridge called the *zygomatic process of the temporal bone* projects outward to link up to the zygomatic bone of the facial-bone region. This linkage forms the *zygomatic arch*. The *mastoid process,* a large protrusion on the lower outer region of the temporal bone, is an important attachment site for several neck muscles. In the same area is the *external auditory meatus* (the earhole leading to the ear canal), positioned at the end of the zygomatic arch.

The *occipital bone* forms the back of the cranium as well as part of the cranium floor. A ridge on the lower portion of the occipital bone, called the *external occipital protuberance,* serves as an attachment site for muscles.

A single bone, called the *frontal bone,* forms the forehead and the upper roof of the *orbital cavities* (eye sockets). The side borders of the frontal bone are where the *superior temporal lines* (temple lines) begin. Each of these marks an important plane change in the structure of the head—the transition from the frontal to the side plane. This plane change is much more noticeable if the face is in a strong light casting shadows that begin at the temple lines and drop the side of the head into deeper tone.

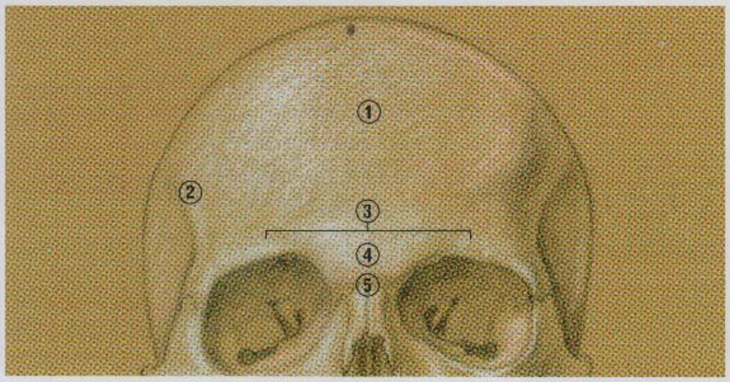
The *superciliary arches* together create a slightly thickened ridge (the brow ridge) along the top of the orbits—a vital bony landmark of the forehead. Between these two arches (between the eyebrows) is a bony wedgelike shape that looks like a keystone. This area is called the *glabella.* At the base of the glabella is an indentation between the frontal bone and the nasal bone. This transition (at the suture joints) is referred to, technically, as the *nasion,* but it is more generally known as the *root of the nose.* It is at this junction that the structure of the nose begins to gently slope forward and away from the face.

Some of the cranial bones are only partly visible on the exterior surface of the skull. The *sphenoid bone* creates the bulk of the cranium floor in the midsection. Only the greater wing of this bone can be seen on a small section of the outer wall of the cranium. A single bone, called the *ethmoid bone,* forms some of the internal structures of the nasal and orbital cavities.

The Facial Bones

Fourteen facial bones together create the bony scaffolding for the muscles of the face. These bones, which with the frontal bone constitute the anterior portion of the cranium, include the structures that form part of the eye sockets as well as the cheekbones, the nasal bones, the upper jaw, the roof of the mouth, and the lower jaw.

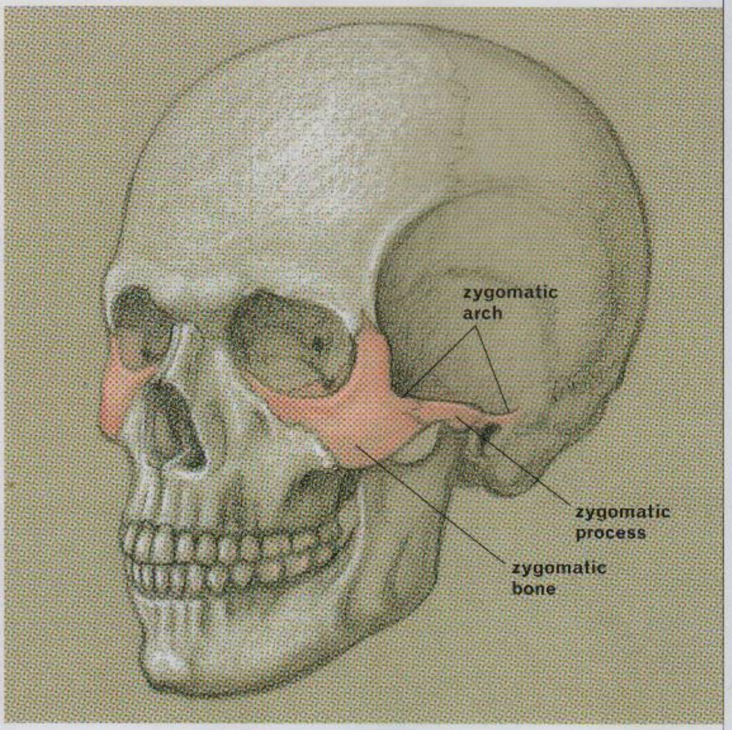
The *zygomatic bones* form the prominent cheekbones as well as the outer and bottom portions of the orbits (eye sockets). Highlights generally catch along the top plane of the cheekbones. The bases



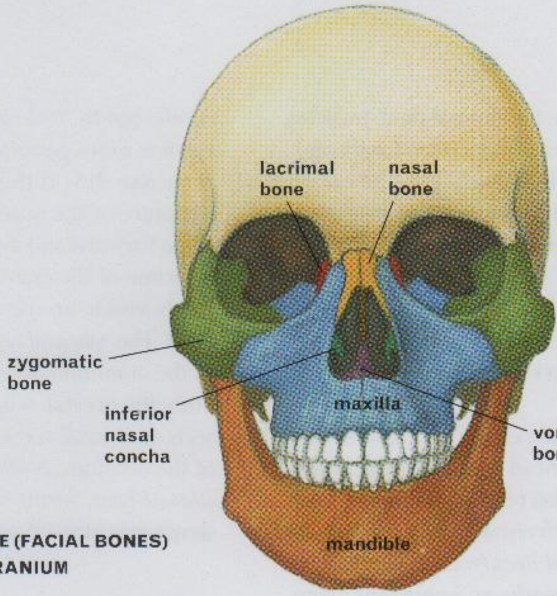
FRONTAL BONE (FOREHEAD)

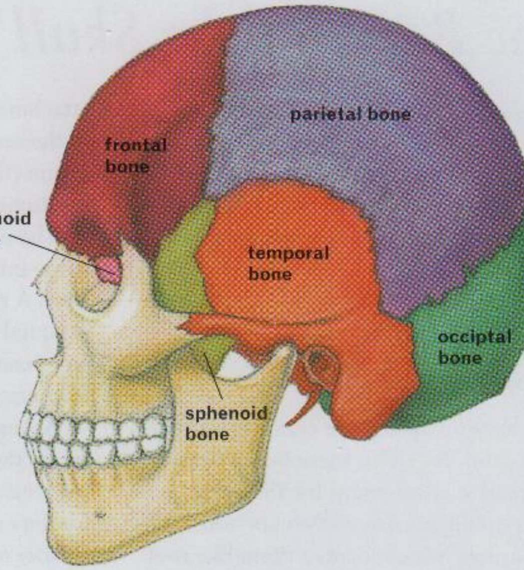
1. frontal bone
2. superior temporal line
3. superciliary arch
4. glabella
5. nasion (root of nose)

GLABELLA



ZYGOMATIC BONES (CHEEKBONES)





Left: **BONES OF THE FACE (FACIAL BONES)**
Right: **BONES OF THE CRANIUM**

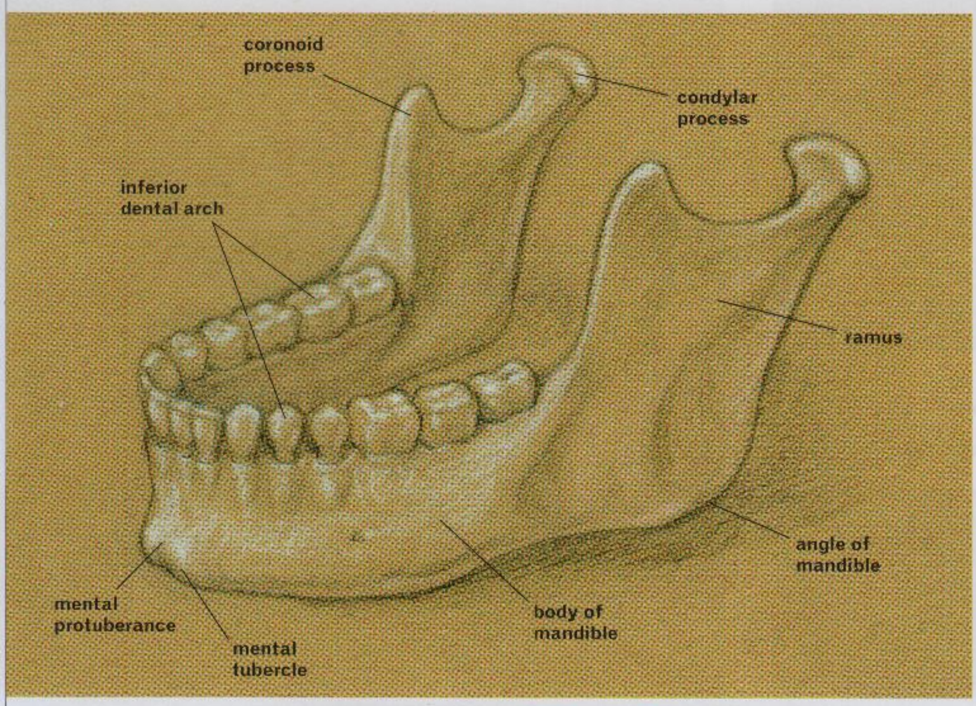
of the cheekbones approximately align with the base of the nose.

The *zygomatic arch* is a bony bridge that is actually made of two components, called the *temporal process of the zygomatic bone* and the *zygomatic process of the temporal bone.* This projecting bridge begins on the side of the cranium (temporal bone) near the ear hole (external auditory meatus) and joins into the cheekbone (zygomatic bone) to form the zygomatic arch. In thinner people a highlight can sometimes be seen along this ridge, running from the cheekbone to the ear.

The two *nasal bones* are joined side by side to form the *bridge of the nose.*

The *maxilla bones* join together to form the frontal aspect of the skull. They contain the *maxillary teeth,* forming the *upper dental arch,* which can influence the surface forms of the cheeks and lips. Because of this, the maxilla bones are sometimes referred to as the upper jaw. They partly surround the *nasal cavity,* creating an inverted heart-shaped aperture. They also form part of the palate (roof of the mouth).

Of all the bones in the skull (including both cranium and facial bones) the *mandible* (lower jawbone) is the only one that is movable. The largest of the facial bones, the mandible is also the strongest.

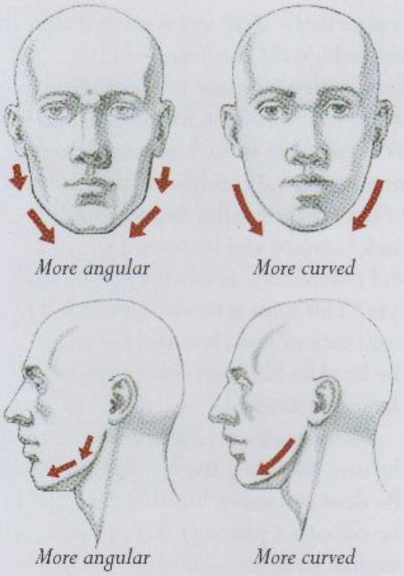


MANDIBLE (LOWER JAW), THREE-QUARTERS VIEW

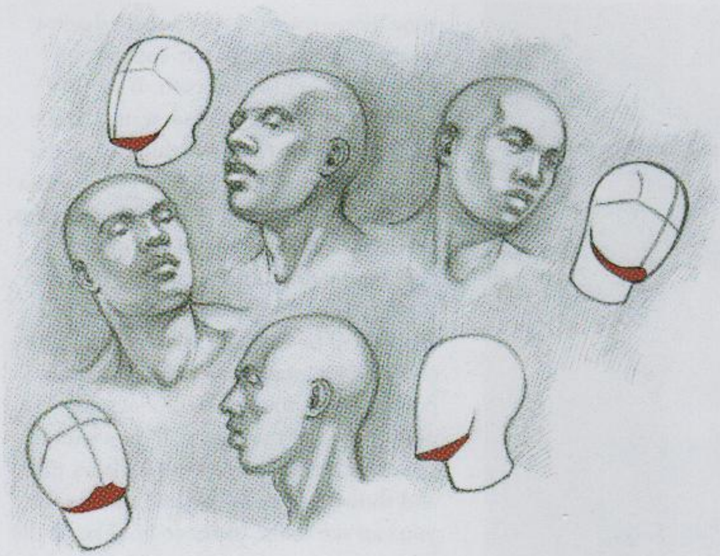
The general *body of the mandible* resembles a horseshoe in shape and holds the teeth of the *lower dental arch.* On each side of the mandible, the *ramus* (pl., rami) extends upward from the body of the mandible; quadrangular in shape, the ramus is thinner-walled than the rest of the mandible. At the upper end of each ramus are two prongs. One is a thin, shark-fin-like projection called the *coronoid process,* which serves as an attachment site for the temporalis muscle. The other, posterior prong is called the *condylar process*; it articulates with the temporal bone of the skull at a joint called the *temporo-mandibular joint,* or TMJ. The TMJ allows the jaw to drop as much as two inches.

The movements of the mandible are the dropping (depression) and lifting upward (elevation) of the jaw, the pulling of the jaw forward (protrusion) and backward (retraction), and side-to-side movements (lateral excursion). The jaw employs these movements primarily for chewing and grinding food, but it is essential for artists (who are more interested in facial expressions) to be aware of these basic movements and how the different positions of the jaw change the shapes of facial forms.

The angular "corner" on the jaw line is called the *angle of the mandible.* There are actually two distinct edges along the jaw line (the outer edge of the mandible): a shorter, steep edge that aligns with the ear and then a longer edge that begins at the corner of the jaw (the angle of the mandible) and sweeps toward the chin. Muscles and other soft tissues are attached along these outer edges, yet



ANGLES OF THE JAW (MANDIBLE)



BOTTOM PLANE OF JAW

CHIN TYPES

it is still possible to detect the jaw line in people whose jaw has an angular quality. People who have more soft tissue padding the cheek area have a softer, curved quality to the edge of the jaw. The shape and size of the jaw varies greatly: Some people have large, robustly shaped jaws; others have jaws that are delicate and more refined.

At the very front of the mandible is the *mental protuberance* (projection of the chin), which is a triangular shape that is part of the bone itself. On both sides of this projection are small bumps called the *mental tubercles*. Like the jaw, the chin can vary greatly among people, with some people having receding chins and others projecting chins. Some chins are rounder; others more angular. Chins can be pointy, oval-like, small and delicate, or large and broad. Paying close attention to the character of the chin as well as the overall shape of the jaw will help you create a more exact likeness when portraying someone.

When the head tilts back, it is possible to see the triangular shape of the *bottom plane of the jaw* positioned above the cylindrical form of the neck. Several muscles run from the edge of the jaw to the hyoid bone, which sits above the voice box. This triangular plane is important to observe, especially in poses where the head looks upward or tilts back.

In addition to the structures described above, there are a number of facial bones that are hard or impossible to detect on the surface form but are worth mentioning here for their basic contributions to the bony structure of the head. The *vomer bone* forms the lower and back portion of the nasal septum, within the nasal cavity. The scroll-like forms of the *inferior nasal conchae* create part of the lateral walls of the sinus cavity. The *lacrimal bones* are small, delicate bones located in the medial portion of the orbital wall of the eye sockets. The *palatine bones,* which help create the back portion of the palate, cannot be seen in either the anterior or lateral views of the skull.

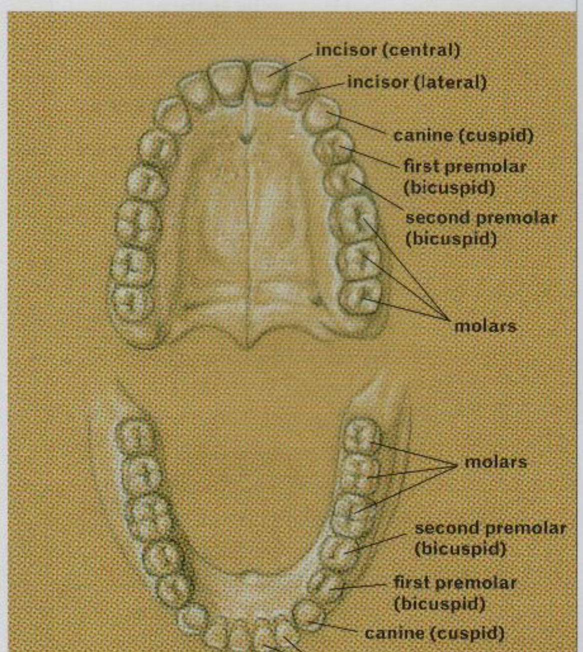
The Teeth

To portray people smiling or showing other expressions that expose the teeth, it is essential that you have some understanding of the basic characteristics of the teeth and their location within the mouth. Depending on their position and shape, the teeth can greatly influence the surface forms of the cheeks and lips.

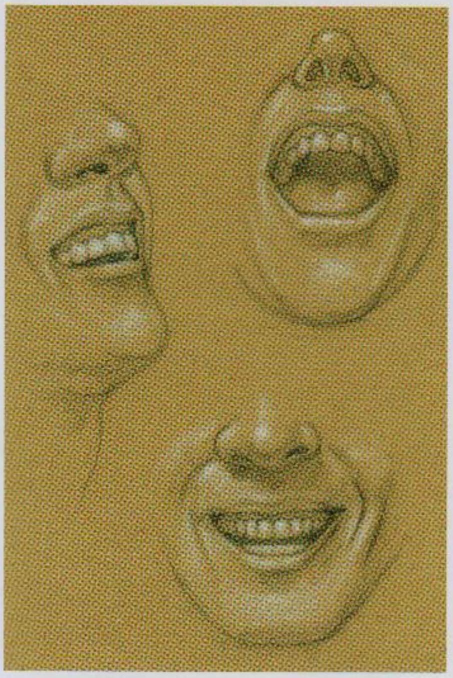
The teeth are positioned in semicircular, or horseshoe-shaped, formations known as the dental arches. The upper dental arch (of the maxilla) has a slightly larger arch than the lower dental arch (of the mandible).

Teeth are mostly composed of a bonelike material called dentin. Each tooth is covered with a thick, durable layer of enamel, which is the hardest substance in the body. Each tooth has three parts: a crown (the exposed part of the tooth, above the gum line), a neck (at the gum line), and a root (anchored in the bony socket called the alveolus). The sockets are covered by the gums (gingivae), which, depending on the individual, can subtly range in hue from pink, to reddish pink, to reddish brown. The teeth and gums tend to have a glistening appearance because they are constantly moistened by saliva.

Teeth are classified according to their function and shape. The main function of teeth is, of course, to tear, chew, and grind food, but it is the shape of the teeth that is of primary interest to artists. The *incisors,* located at the front of both dental



THE TEETH
Top: Upper dental arch. Bottom: Lower dental arch.



STUDIES OF THE TEETH IN EXPRESSIONS

arches, are chisel-shaped or slightly shovel-like in appearance. Of the four upper incisors, the two central ones are the largest. The four smaller incisors in the lower dental arch are all approximately the same size. On either side of the incisors are the *canine teeth,* or cuspids, which tend to be cone-shaped. After the canines come the *premolars,* or bicuspids, which are wedge-shaped; generally, each premolar has two rounded cusps (bumps) on its surface. Finally, there are the *molars,* which are larger and more box-shaped than the other teeth; each molar usually has four or five cusps.

On average, people have thirty-two teeth, although some may have lost teeth or had them removed for any of a number of reasons, including overcrowding. Teeth show a great variety of shapes, sizes, and positioning from person to person, and all these characteristics affect the softer surface forms of the face. With the loss of teeth, the bony sockets are absorbed and the jaws sometimes become smaller. This is one reason that elderly people's lips may have a collapsed appearance.

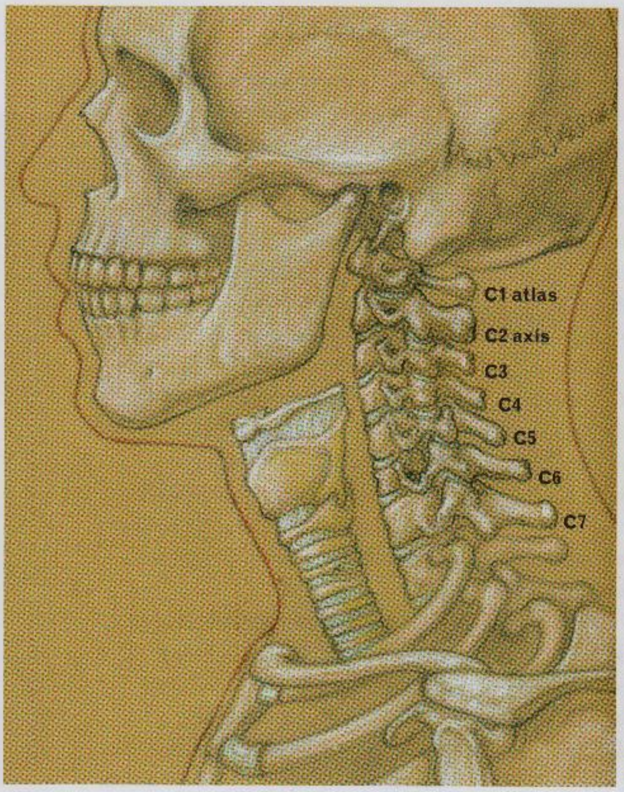
When drawing or painting someone's teeth, keep in mind that the result will look better if you do not heavily outline each tooth shape. If the lips are parted (as in a smile), the light source will generally hit the front section of the teeth; the other teeth will take on a more subdued tone. Sometimes, a very subtle shadow cast by the upper lip may appear on the upper part of the teeth. If you are doing a highly realistic portrait, slightly indicate the glistening highlights on the teeth and gums (and lips) to give them a more natural quality. For quicker studies, getting the basic shape of the mouth and the general outline of the gums and teeth (with no separation of individual teeth) will be enough. When the mouth is open in a more dynamic expression, pay attention to the placement and perspective of the dental arches within the mouth cavity. Keep the incisors thin, and show the premolars and molars, if you can see them, as more boxlike. If the tongue appears, keep the shape simple and organic with a slight glistening highlight. In any open-mouthed expression, the lips will stretch—either vertically as the jaw drops down or horizontally over the teeth, as in a smile or grimace.

The Cervical Vertebrae of the Neck

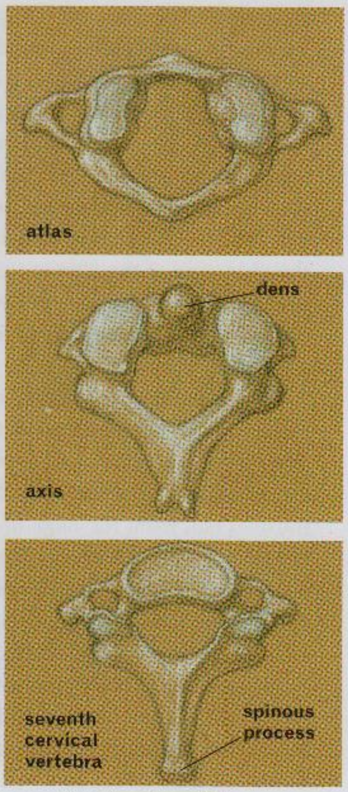
The seven cervical vertebrae (neck bones) are stacked on top of each other, forming a slight curve when viewed from the side. The first vertebra, called the *atlas,* supports the skull and is named after the mythological Titan who held the heavens (or, in some versions of the story, the world) on his shoulders. This vertebra articulates with two small occipital condyles at the base of the cranium, allowing the head to rock forward and backward (flexion and extension), as when a person nods "yes." This joint articulation (with the assistance of muscles) also allows the head to tilt from side to side (lateral flexion).

The second cervical vertebra, called the *axis,* has a peg-like projection called the dens (meaning "tooth"; also called the odontoid process) that fits into the ringlike structure (anterior arch) of the atlas. The dens acts as a pivot for the rotation of the atlas and the skull, helping the head to swivel in a rotational movement, as when a person shakes his or her head "no."

The *seventh cervical vertebra* (vertebra prominence C7) has a longer spinous process than do the other cervical vertebrae and can be seen as a slight bump on the surface form. This small landmark is essential because it indicates the base of the neck and the general transition from the neck to the ribcage in both side and back views.



Lateral view of cranium with the cervical vertebrae and the larynx



Superior views of three cervical vertebrae

CERVICAL VERTEBRAE OF THE NECK

WOMAN WITH LONG HAIR

The Muscles of the Head, Face, and Neck

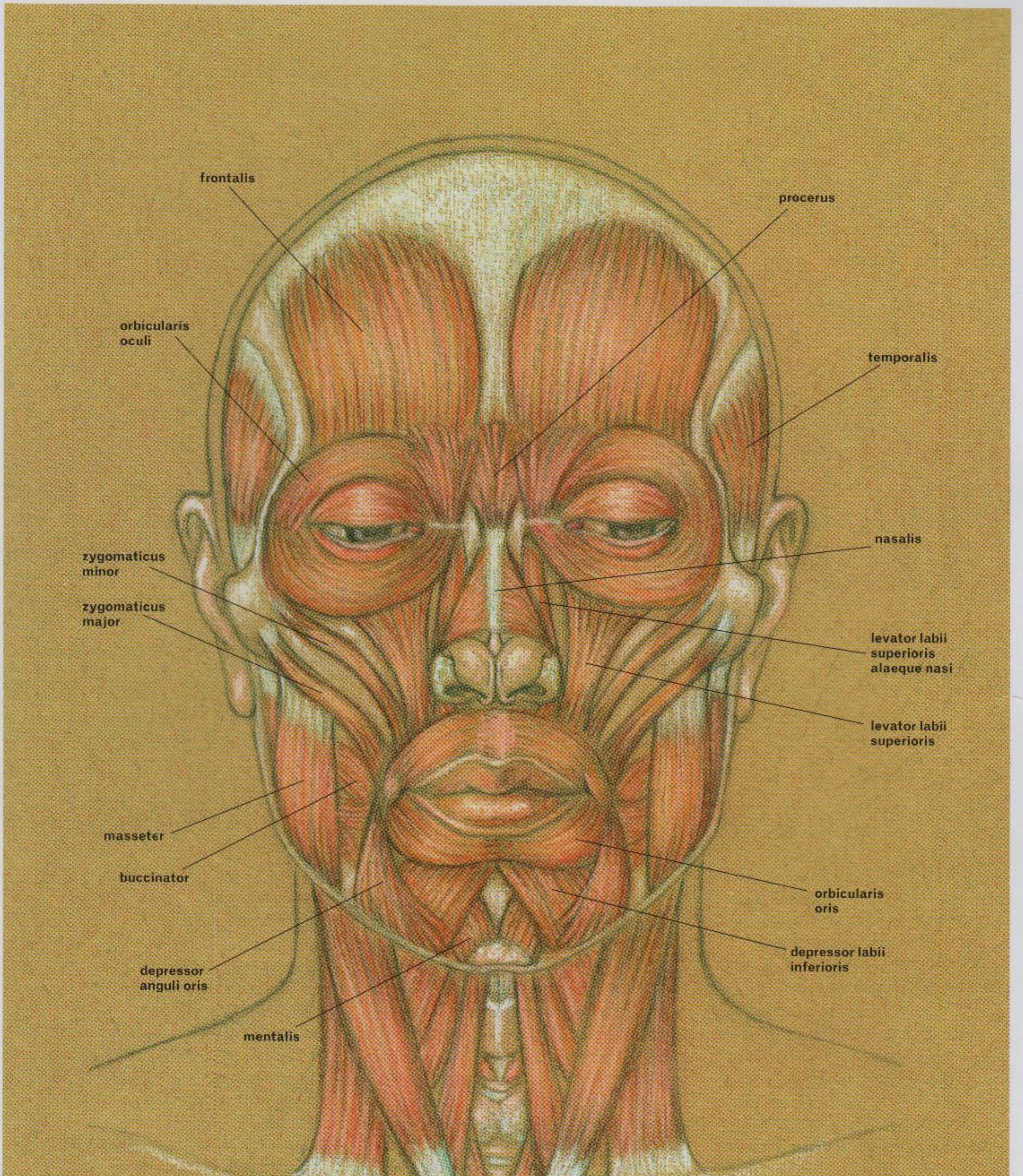
Learning about the muscles of the head and face can help you understand facial expressions better. Many artists, including animators, illustrators, storyboard artists, comic book artists, and portrait artists (whether working in two or three dimensions) constantly utilize the expressions of the face. The information provided here is only an introduction to how the individual facial muscles can alter the features and soft tissues of the face.

Each muscle or group of muscles, when it contracts, plays a unique role in affecting a certain part of the face. It is the combination of the actions of all these isolated areas that gives us the complex, exciting repertoire of facial expressions. There are thousands of various facial-action combinations, yielding instantly recognizable expressions such as anger, sadness, and joy, as well as all the subtler changes to a person's countenance.

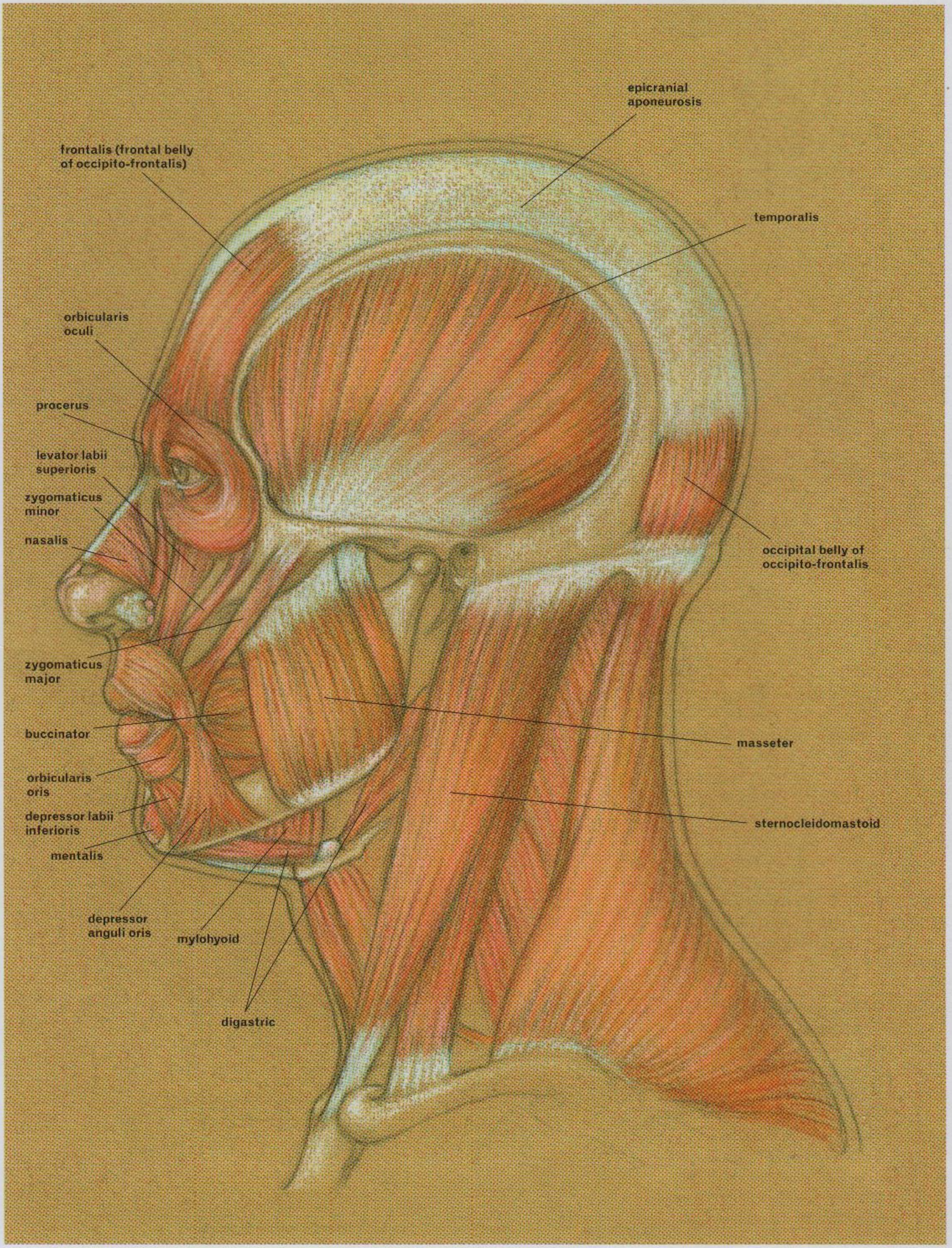
It is important for figurative artists to learn the skull landmarks, the general proportions of the head, and the shapes of the facial features. But the real challenge comes in trying to observe the activity of the muscles of the head and to learn their effect on facial expressions. The facial muscles are difficult to locate on the living model because soft-tissue forms such as glands, fatty tissues, and superficial fascia cover up most of the muscular layers, making it hard to see the shapes of the muscles themselves.

Whereas the skeletal muscles of the rest of the body usually attach from bone to bone, the muscles of the face generally begin on a bone and then insert into skin, muscles, connective tissues, or a combination of several structures. (The exceptions are the muscles of the mandible and neck region.) When the facial muscles contract, they do not just change shape but also alter the shape of the softer tissues near their attachments, affecting the surface of the skin and creating the folds and wrinkles that accompany certain expressions.

The features most affected by facial muscles are the eyes, eyebrows, and mouth. One way to learn the facial muscles is to divide them into groups and study how the muscles of each group manipulate and alter these particular features. Some groups of facial muscles connect to a particular individual muscle. For instance, several muscle groups and individual muscles connect to the orbicularis oris (the disclike muscle of the mouth); depending on which muscles or muscle groups are contracting, the mouth and the area around it can adopt a wide variety of different expressions. Because of this, the facial muscles are sometimes referred to as the *muscles of expression*.



MUSCLES OF THE HEAD (ANTERIOR VIEW)



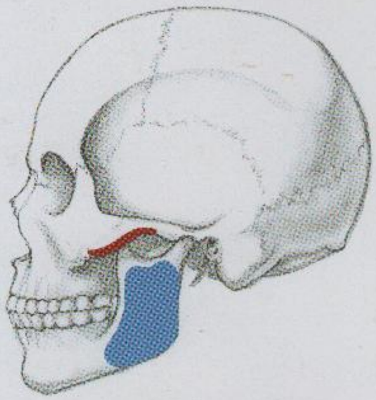
MUSCLES OF THE HEAD (LATERAL VIEW)

Masseter

PRONOUNCIATION
MASS-ee-tur *or* maa-SEE-tur

ORIGIN OF THE TERM
Greek *maseter* = masticator, chewer

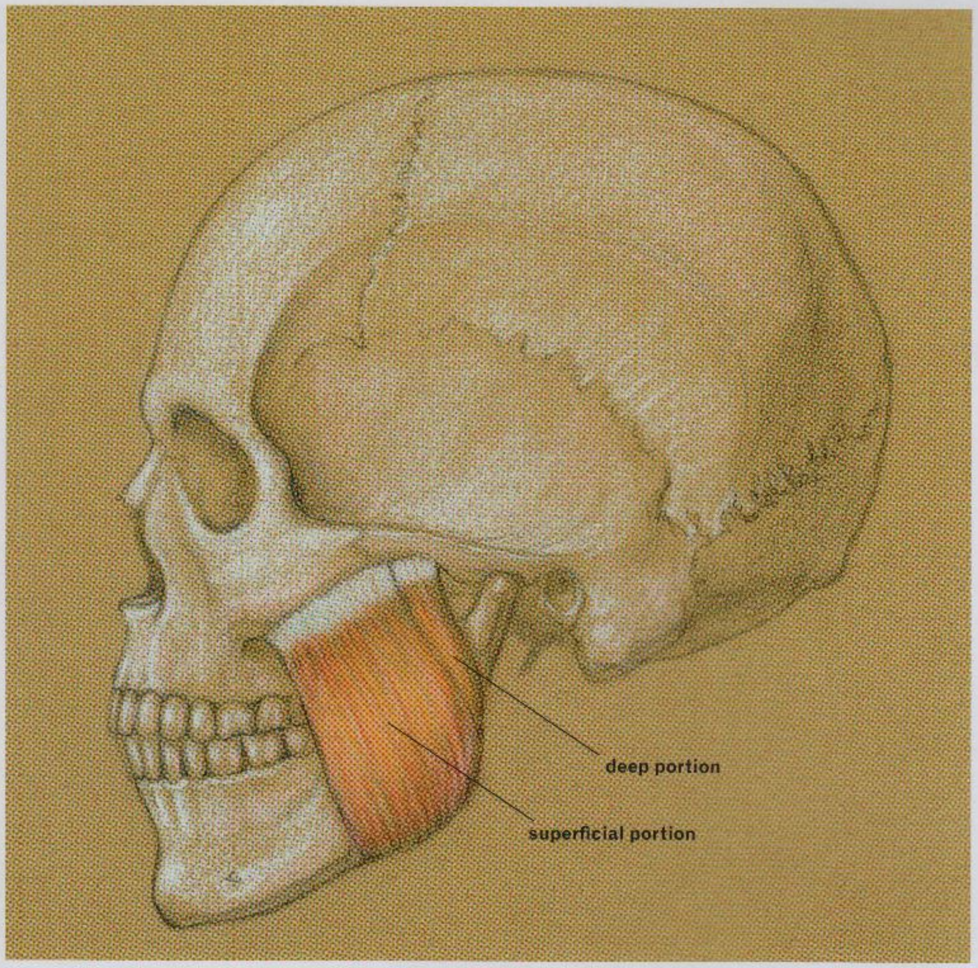
SYNONYMS
musculus masseter (TA), chew muscle



MASSETER—MUSCLE ATTACHMENTS

ORIGIN
- zygomatic arch
- maxillary process of zygomatic bone

INSERTION
- outside surface of mandible (ramus of mandible)
- angle of mandible



MASSETER

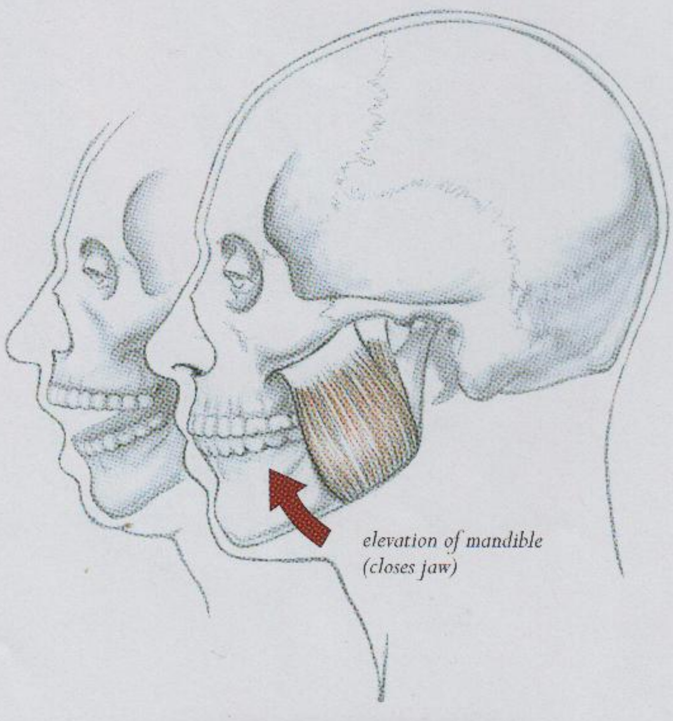
Masseter

The masseter, which helps us chew, is a powerful muscle that lies obliquely on the side of the jaw. It has a quadrangular (square) shape and is anchored along the lower edge of the zygomatic arch. The masseter inserts into most of the outside surface of the ramus of the mandible.

The masseter has a superficial portion and a deep portion. The superficial portion (along with the salivary gland called the parotid gland) fleshes out the side of the face on the surface form. The masseter ripples and bulges under the skin when someone chews or clenches his or her teeth.

ACTION OF THE MUSCLE

The masseter is the main muscle (prime mover) involved in closing the jaw—or, in anatomical terms, elevating the mandible. After the mouth has opened and the jaw drops, this muscle lifts the mandible back into its natural position. It also helps to protract the jaw (the action of jutting the jaw slightly forward) and to clench the teeth, which occurs both in chewing and when a person feels emotional tension.



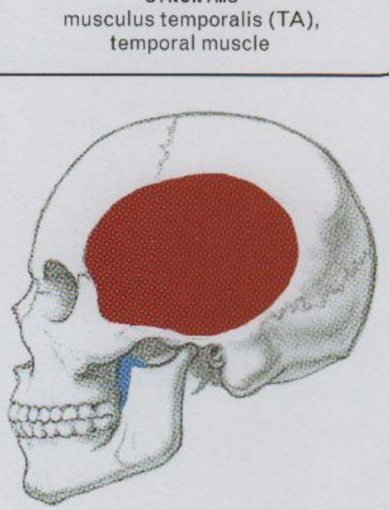
MASSETER—ACTION OF MUSCLE

Temporalis

PRONOUNCIATION
TEM-poor-AL-liss *or* TEM-poh-RA-liss

ORIGIN OF THE TERM
Latin *temporalis* = belonging to the temples

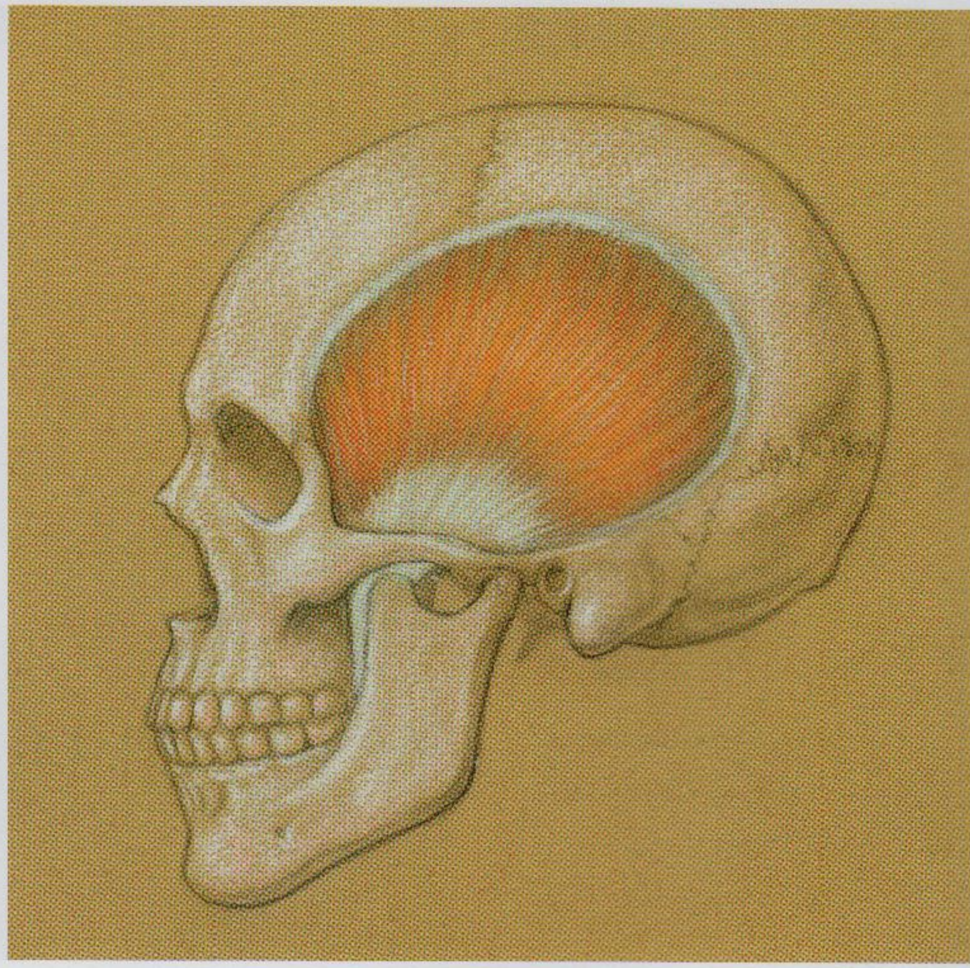
SYNONYMS
musculus temporalis (TA), temporal muscle



TEMPORALIS—MUSCLE ATTACHMENTS

ORIGIN
- temporal fossa of cranium
- temporal fascia

INSERTION
- mandible (coronoid process)
- mandible (anterior border of ramus)



TEMPORALIS MUSCLE

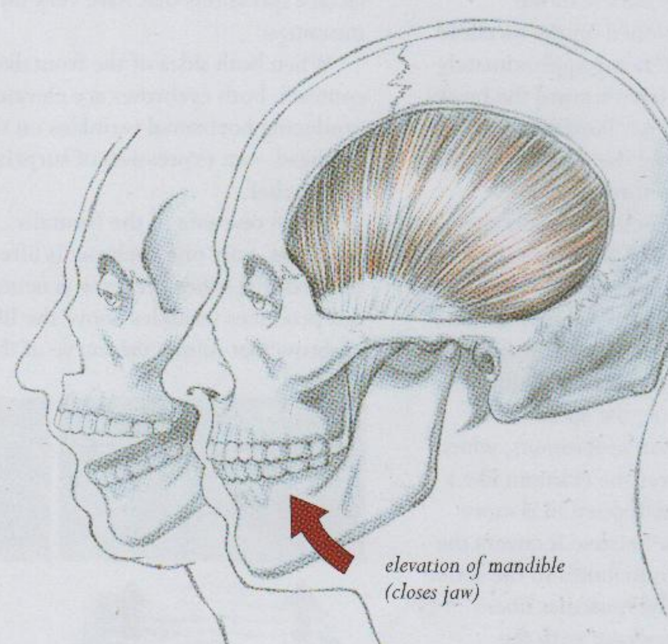
Temporalis

The temporalis muscle is a flat, fan-shaped muscle that attaches to the temporal fossa located on the outer side of the cranium. The muscle fibers converge into a tendon, which moves behind the zygomatic arch to insert into the coracoid process of the mandible (the shark-fin-like projection near the hinge joint of the mandible). The temporalis is covered by the *temporal fascia,* which attaches to the upper edge of the zygomatic arch. Fatty tissue lying beneath the fascia and on top of the temporalis muscle softens the transition from the side of the head to the zygomatic arch.

The temporalis muscle is generally hidden by hair, but if a person is bald, this muscle can be detected as a very slight bulge near the temple line when the jaw is opening or closing, as in the action of chewing.

ACTION OF THE MUSCLE

The more vertical muscle fibers of the temporalis help elevate the mandible in the action of closing an opened jaw. The more horizontal muscle fibers assist in the action of retracting the mandible—pulling the jaw backward from a protracted, or forward, position.



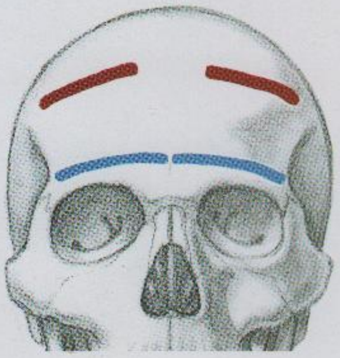
TEMPORALIS—ACTION OF MUSCLE

Frontalis

PRONOUNCIATION
frun-TAY-liss *or* frun-TAL-iss

ORIGIN OF THE TERM
Latin *frons* or *frontis* = forehead, brow

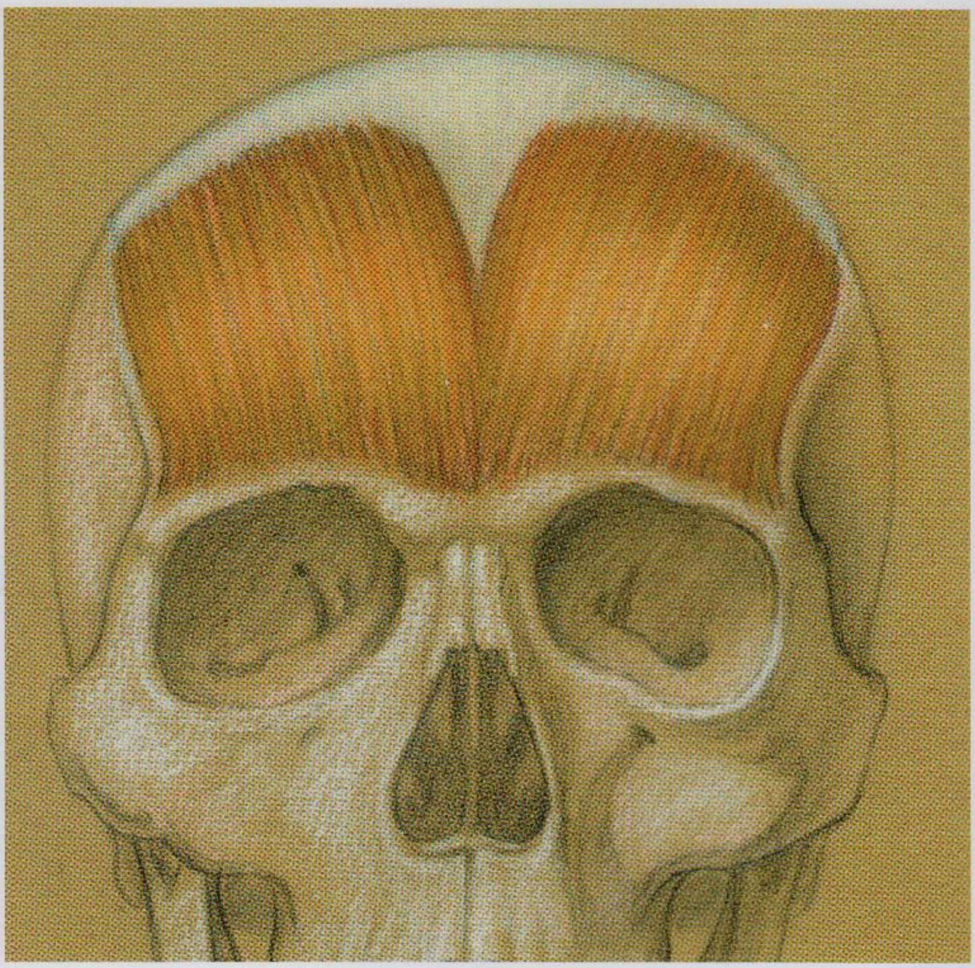
SYNONYMS
musculus occipitofrontalis (TA), venter frontalis (TA), occipito-frontalis, epicranius muscle, frontal belly, muscle of forehead



FRONTALIS—MUSCLE ATTACHMENTS

ORIGIN
- front border (near hairline) of epicranial aponeurosis

INSERTION
- skin and subcutaneous tissue of eyebrow



FRONTALIS

Frontalis

The frontalis—the muscle of the forehead—is positioned on the forehead (frontal bone), extending approximately from the hairline down toward the brow ridge. Its right and left borders are near the temple lines, and the muscle is divided in the center of the forehead.

The frontalis muscle is actually the *front portion (frontal belly) of the occipito-frontalis* muscle. A *posterior belly,* called the *occipital portion,* is located on the back of the skull and is usually hard to detect if someone is not bald. These two muscle bellies are connected by a wide, flat aponeurotic tendon (the *epicranial aponeurosis*), which stretches tightly over the cranium like a skullcap. The frontalis portion is more important to know because it covers the frontal bone and contributes to the action of the eyebrows. The muscular fibers of this muscle interweave with the fibers of the orbicularis oculi and the procerus muscles.

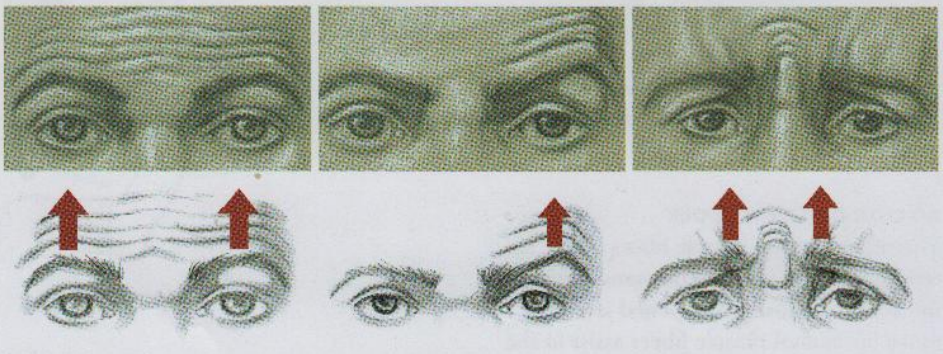
ACTION OF THE MUSCLE

The frontalis can contract in three different ways, producing three different facial expressions that have very different meanings:

When both sides of the frontalis contract, both eyebrows are elevated, producing horizontal wrinkles on the forehead—an expression of surprise or disbelief.

When one side of the frontalis contracts, only one eyebrow is lifted upward (the other eyebrow is neutral); this produces wrinkles above the lifted eyebrow that mimic the curve of the eyebrow itself. Actually, not everyone can perform this action. Among those who can, it is an expression of bemusement or perhaps of amused distrust (the "arching of the eyebrow").

When the inner ends of the frontalis contract, the inner ends of the eyebrows are elevated, producing a horseshoe-shaped wrinkle in the glabella region and vertical and curved horizontal wrinkles on the forehead—an expression of sadness or grief.



Both sides contracting *One side contracting* *Inner ends contracting*

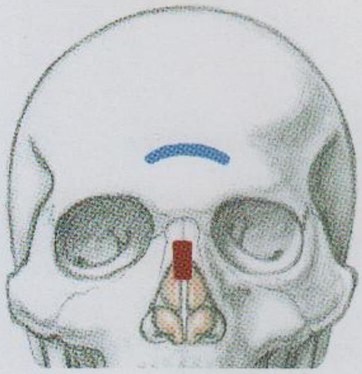
FRONTALIS—ACTION OF MUSCLE

Procerus

PRONOUNCIATION
pro-SAIR-us *or* pro-SEE-rus
or pro-SIR-us

ORIGIN OF THE TERM
Latin *procerus* = long, tall

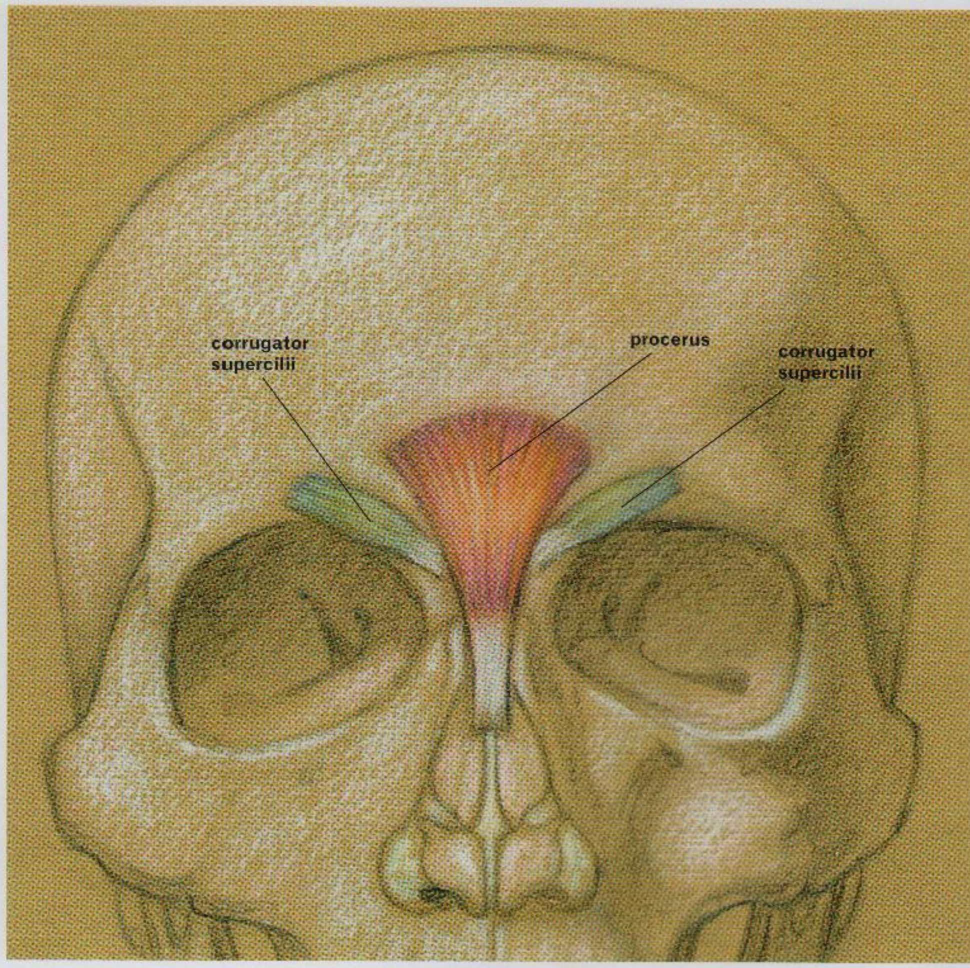
SYNONYMS
musculus procerus (TA),
pyramidalis nasi, depressor glabellae



PROCERUS—MUSCLE ATTACHMENTS

ORIGIN
- fascia of upper part of lateral nasal cartilage
- fascia of nasal bone

INSERTION
- into skin of central region of forehead



PROCERUS
Shown with corrugator supercilii muscles

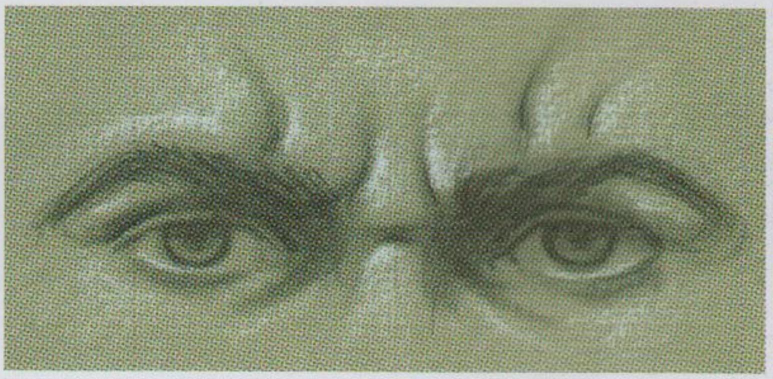
Procerus

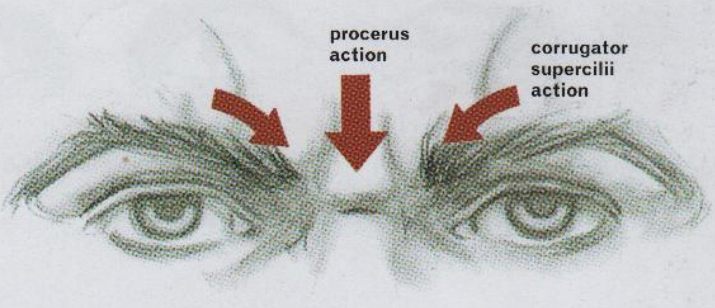
The procerus is a fan-shaped muscle positioned in the lower central region of the forehead. It attaches to the fascia on the cartilage of the nose as well as to the nasal bone. The fibers interweave with those of the frontalis muscle and with some of the fibers of the depressor supercilii of the orbicularis oculi muscles.

In the drawing at top right, the *corrugator supercilii* muscles are depicted with the procerus muscle. They are positioned under the orbicularis oculi muscles, making it difficult to detect on the surface form except when the muscles are in full contraction.

ACTION OF THE MUSCLE

With the assistance of the corrugator supercilii and the depressor supercilii muscles, the procerus contracts to depress the medial ends of the eyebrows (that is, to lower the eyebrows' inner ends), producing horizontal wrinkles near the root of the nose. This action is commonly called "knitting the eyebrows" and may be an expression of annoyance, anger, or intense concentration.





Depresses inner ends of eyelids

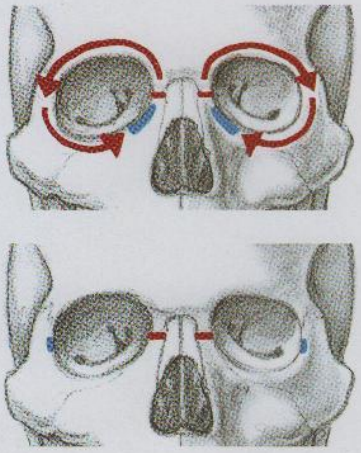
PROCERUS—ACTION OF MUSCLE

Orbicularis Oculi

PRONOUNCIATION
or-BICK-yoo-LAR-iss OCK-yoo-lie
or
or-BICK-kyoo-LAIR-riss OCK-yoo-lee

ORIGIN OF THE TERM
Latin *orbicularis* = diminutive of *orbis* = circle, disc + *oculi* = of the eyes

SYNONYMS
musculus orbicularis oculi (TA), orbicularis palpebrarum, orbicular muscle of the eye



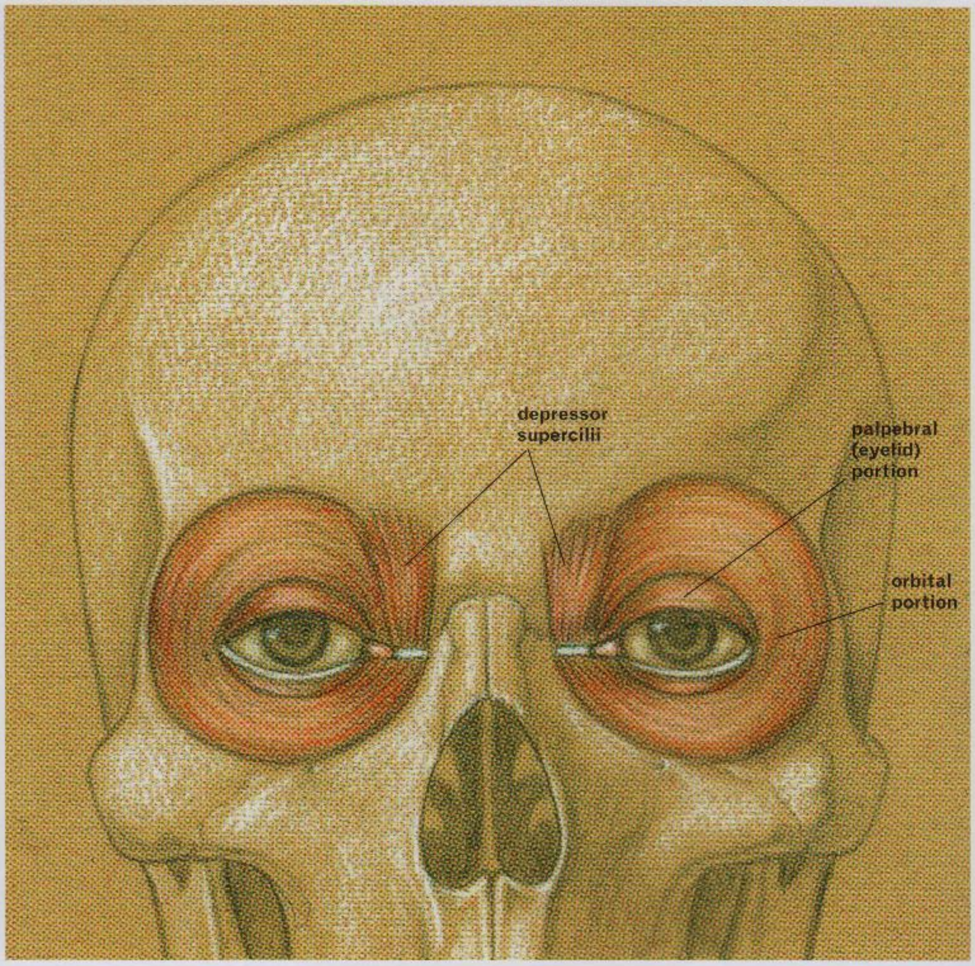
ORBICULARIS OCULI—MUSCLE ATTACHMENTS

ORIGIN (ORBITAL PORTION)
■ medial palpebral ligament

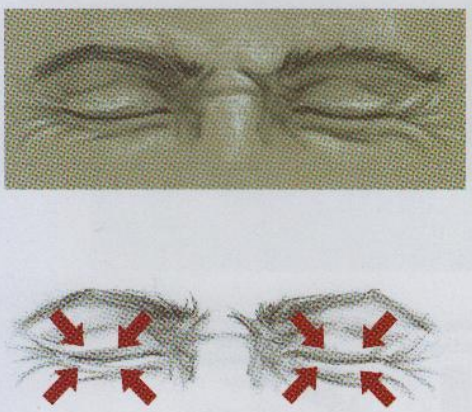
INSERTION (ORBITAL PORTION)
■ below medial palpebral ligament

ORIGIN (PALPEBRAL [EYELID] PORTION)
■ medial palpebral ligament

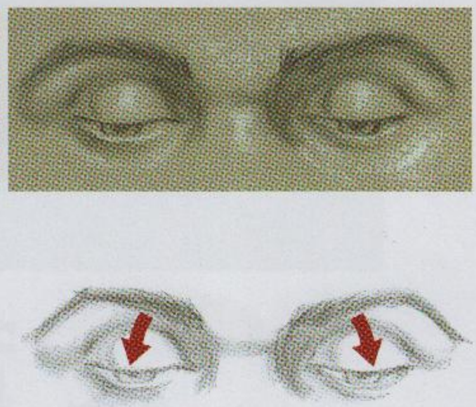
INSERTION (PALPEBRAL PORTION)
■ lateral palpebral ligament (raphe)



ORBICULARIS OCULI MUSCLE



Orbital portion closes eyelids tightly



Palpebral portion closes eyelids gently

ORBICULARIS OCULI—ACTION OF MUSCLE

Obicularis Oculi

The orbicularis oculi is a disc-shaped muscle that completely surrounds each eye socket (orbit). It has two main parts, both of which are important for the artist to know: the thick *orbital portion,* which attaches around the eye socket, and the thinner *palpebral portion,* which lies within the eyelids. Yet a third part, called the *lacrimal portion,* lies behind the eyes near the tear duct and is not visible on the surface.

The orbital portion of the orbicularis oculi begins near the inner eye on the medial palpebral ligament and the nasal part of the frontal bone. As the muscle travels around the eye socket, its fibers overlap the frontal bone, temple, cheekbone, and lower orbital rim to attach below the medial palbebral ligament.

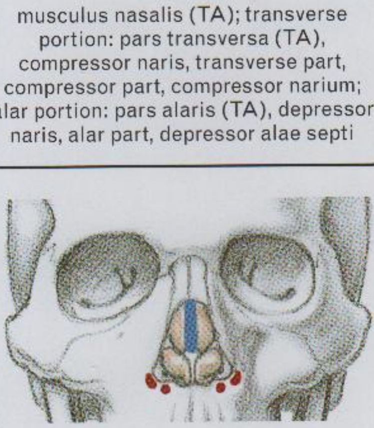
The delicate skin of the eyelid covers the very thin muscular fibers of the palpebral portion of the orbicularis oculi. This portion of the muscle begins near the inner eye, at a short fibrous band called the *medial palpebral ligament.* It then inserts

Nasalis

PRONOUNCIATION
nay-ZAL-iss *or* NAY-zah-liss
or nay-ZAY-liss

ORIGIN OF THE TERM
Latin *nasus* = nose

SYNONYMS
musculus nasalis (TA); transverse portion: pars transversa (TA), compressor naris, transverse part, compressor part, compressor narium; alar portion: pars alaris (TA), depressor naris, alar part, depressor alae septi



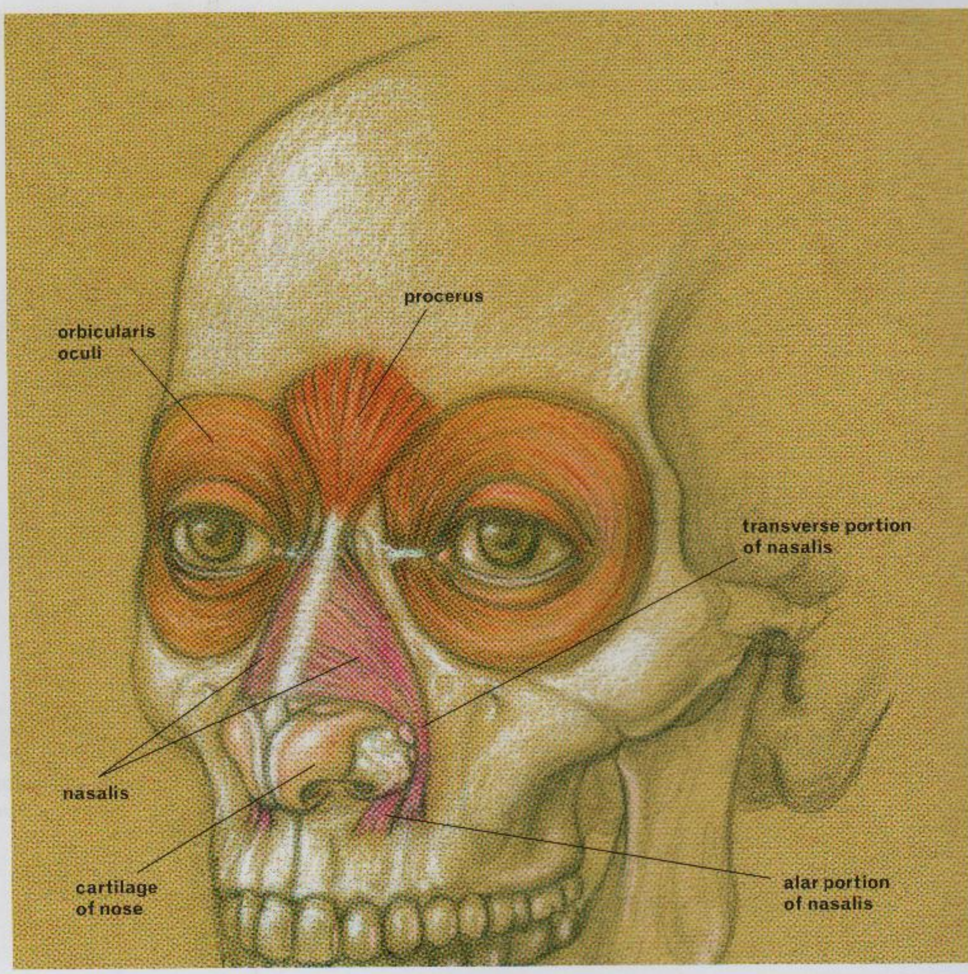
NASALIS—MUSCLE ATTACHMENTS

ORIGIN (TRANSVERSE PORTION)
- maxilla, near lower outside nasal cavity

INSERTION (TRANSVERSE PORTION)
- fascia (aponeurosis) on top plane of nose, joining same muscle from other side

ORIGIN (ALAR PORTION)
- maxilla, below nasal cavity, above lateral incisor tooth

INSERTION (ALAR PORTION)
- skin of nose
- lower margin of nostril



NASALIS
Three-quarters view of face

on the outer corner of the eye (the *lateral angle of the eye*) at the *lateral palpebral ligament*, or *lateral palpebral raphe*. Even though the eyelids are extremely thin, you can still see their outer rims, especially in the lower lid as it wraps around the eyeball.

The fibers of the orbicularis oculi interweave with the muscles of the frontalis and the procerus. On the medial side of the orbicularis oculi is a small, triangular patch of muscle fiber that some anatomists consider a separate muscle. It is called the *depressor supercilii,* and its fibers interweave with those of the procerus and the frontalis.

ACTION OF THE MUSCLE

The orbital portion of the orbicularis oculi is a circular-fiber muscle, which means that the muscle fibers form rings around the orbit; when the muscle contracts, it squeezes the eye shut, as when someone squints or winks. This action produces "crow's feet"—folds or wrinkles in the skin radiating outward from the outer corner of the eye. The palpebral portion of the orbicularis oculi gently closes and opens the eyelids, as in the blink reflex, and lowers the lids for sleeping and meditation. As the orbicularis oculi contracts, the skin beneath the eye is also pushed slightly upward.

Nasalis

The nasalis, or nose muscle, consists of two portions: the *transverse portion* and the *alar portion*. The transverse portion begins at the maxilla bone near the lower outside nasal cavity (above the location of the canine tooth), from which it moves upward along the side of the nose. The muscle fibers fan outward as it inserts into the fascia on the top plane of the nose, joining the same muscle from the other side.

The alar portion also begins on the maxilla, near the transverse portion and above the lateral incisor (the second tooth from midline). It inserts into the skin at the lower margin of the nostril.

ACTION OF THE MUSCLE

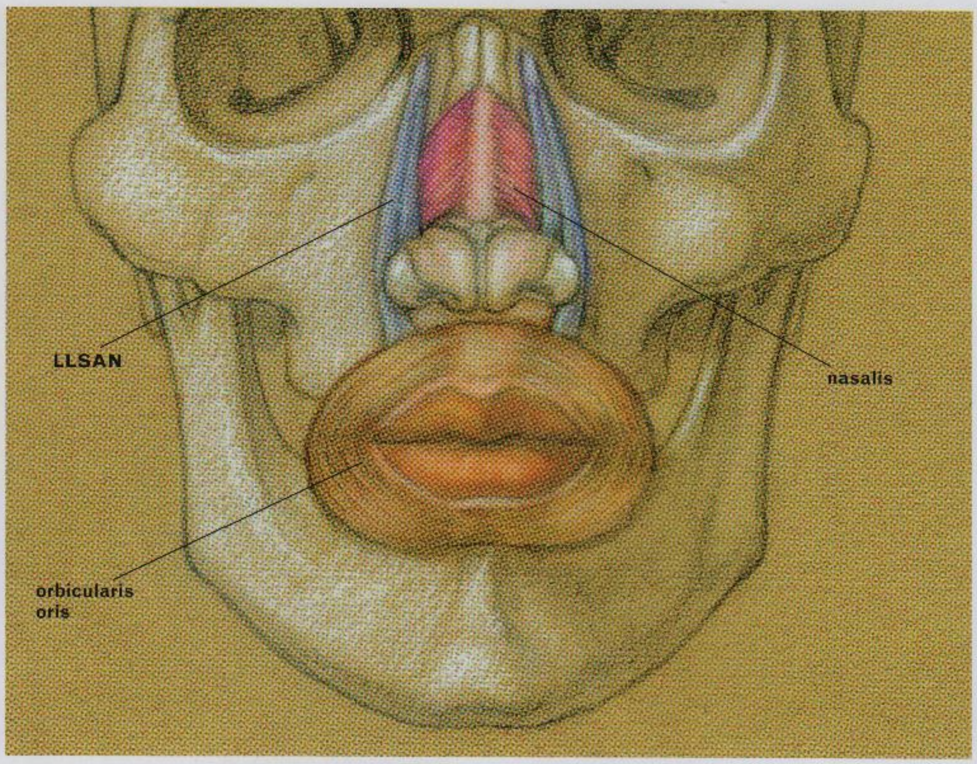
The action of the nasalis is very subtle and hard to detect on the surface form; for that reason, no action diagram is included here. The transverse portion (*compressor naris*) compresses the nostrils toward the septum. The alar portion draws the alar cartilage of the nose somewhat downward, resulting in the slight enlarging of the nostrils.

Levator Labii Superioris Alaeque Nasi (LLSAN)

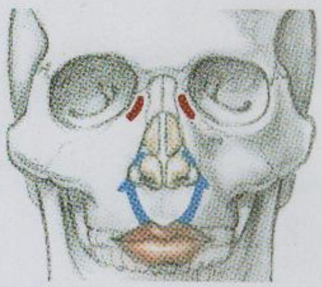
PRONOUNCIATION
LEV-uh-tor LAY-bee-eye
soo-PEER-ee-OR-iss
uh-lee-kwee NAY-zee
or
leh-VAH-tor LAY-bee-eye
soo-PEER-ee-or-iss
uh-LEE-qwee NAYZ-eye

ORIGIN OF THE TERM
Latin *levator* = a raiser or lifter + *labium* = lip + *superioris* = above + *ala* = wing + *que* = and + *nasi* = nose

SYNONYMS
musculus levator labii superioris alaeque nasi (TA), levator alae nasi, levator labii superioris et alae nasi, angular head of the quadratus labii superioris, nasal portion of the levator labii superioris muscle



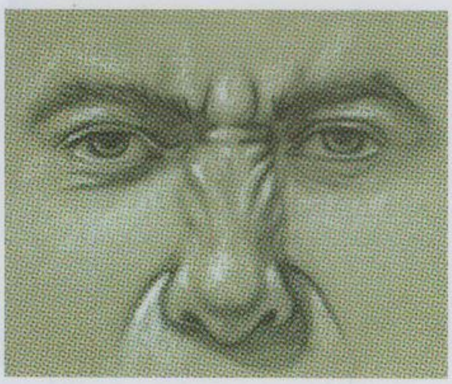
LEVATOR LABII SUPERIORIS ALAEQUE NASI (LLSAN)
With nasalis and orbicularis oris

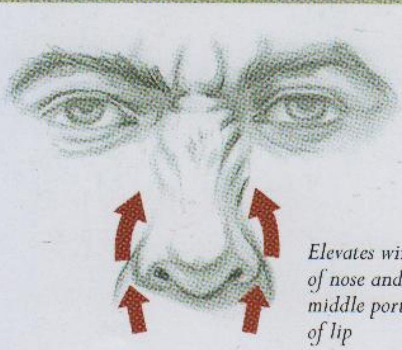


LLSAN—MUSCLE ATTACHMENTS

ORIGIN
- maxilla, near root of nose and inner corner of eye

INSERTION
- alar cartilage of nose (wing of nose)
- skin of upper lip
- into skin of nasolabial furrow





Elevates wings of nose and middle portion of lip

LLSAN—ACTION OF MUSCLE

Levator Labii Superioris Alaeque Nasi (LLSAN)

The levator labii superioris alaeque nasi (LLSAN) elevates the upper lip and the wing of the nose. The LLSAN is divided into two elongated strips (called the lateral and medial slips) that pass down along side of the nose. Some sources consider the LLSAN the nasal portion of the levator labii superioris muscle and do not treat it as a separate muscle.

ACTION OF THE MUSCLE

When the LLSAN muscle contracts, it elevates the wings of the nose and the middle portion of the upper lip. It also elevates the nasolabial furrow, the crease that curves from the outside of the wing of the nose downward around the mouth.

During contraction of the muscle, various obvious wrinkles occur on the side of the nose and near the bridge of the nose. This is the muscle that "crinkles" and wrinkles the nose area in expressions of disgust.

Orbicularis Oris

The orbicularis oris muscle, which includes the lips, has a circular shape much like the round muscle of the eye (orbicularis oculi). Although it looks like a simple form at first glance, its simplicity is deceptive. The orbicularis oris is actually a very complex form because so many muscles of the face interweave into its fibers. These various elevator and depressor muscles help lift or pull down the lips, producing a wide range of expressions in the mouth region.

The muscle consists of the upper and lower lip portions, as well as an outer, peripheral portion that inserts into the *modiolus*. The modiolus, whose name comes from the Latin word for "hub," is a connective-tissue structure formed by the many interweaving muscles that inserts or attach near the corners of the mouth. The modiolus appears on the surface form as a small fleshy mound at each end of the lips. Shadows and tones sometimes catch along its bottom border, making it look like a little tuck of skin.

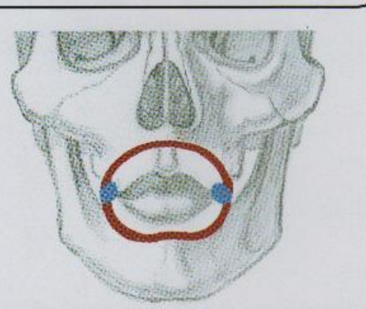
The texture and coloring of the lips is usually different from the rest of the skin of the face. Sometimes the lip portions are referred to as the *vermilion zone of the lips* or the *transitional zone of the lips,* but the terms *upper lip* and *lower lip* are more commonly used. The color of the lips is not always a reddish hue; it can range from a deep, rich brown to a peachy pink color, depending on the individual. Several terms are used to indicate

Orbicularis Oris

PRONOUNCIATION
or-BICK-yoo-LAR-iss OR-iss
or
or-BICK-kyoo-LAIR-riss OR-iss

ORIGIN OF THE TERM
Latin *orbiculus* = diminutive of *orbis* = circle, disc + *oris* = of the mouth

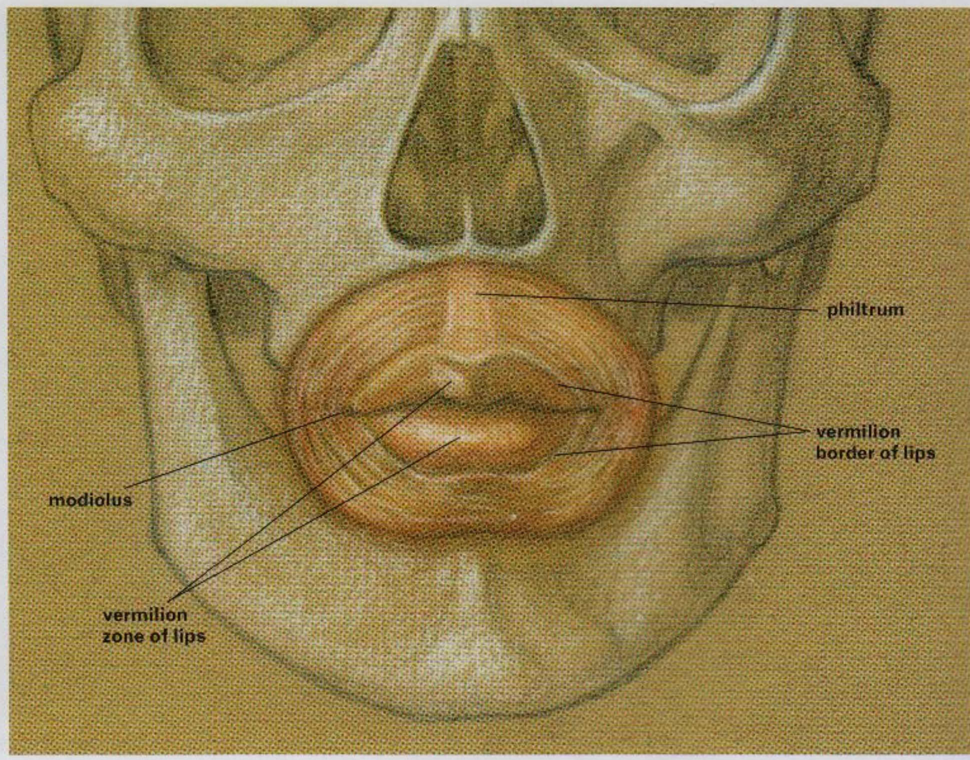
SYNONYMS
musculus orbicularis oris (TA), whistling muscle, kissing muscle, orbicular muscle of the mouth



ORBICULARIS ORIS—MUSCLE ATTACHMENTS

ORIGIN
- maxilla and mandible at midline
- from other facial muscles
- skin and fascia around lips

INSERTION
- angle of mouth (modiolus)



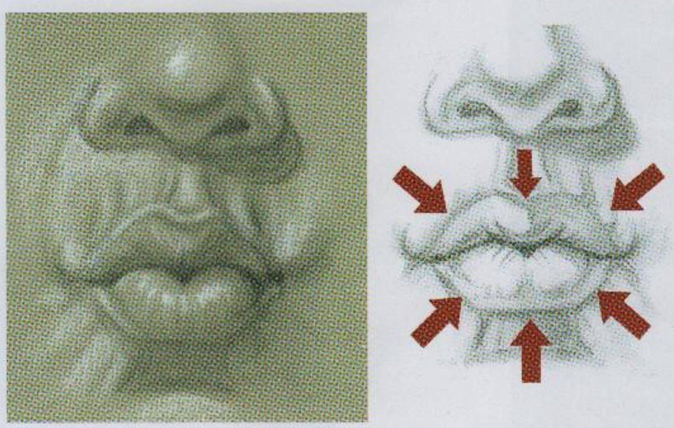
ORBICULARIS ORIS

the borders of the lip portion and its separation from the rest of the orbicularis oris muscle: the *vermilion border of the lips*, the *red margins of the lips*, the *red lip borders*, and the *rosy borders*. Around the perimeter of the lips is a ridge that is actually a fibrous tissue, separating the skin from the form of the lips. This ridge can catch highlights and tends to be more easily seen on darker skin. The ridge dips around the lower border of the philtrum (from Greek *philtron*, "love charm"), a shallow vertical groove extending from the upper lip to the nasal septum. The shape of the upper lip (along the ridge) is occasionally referred to as the "cupid's bow."

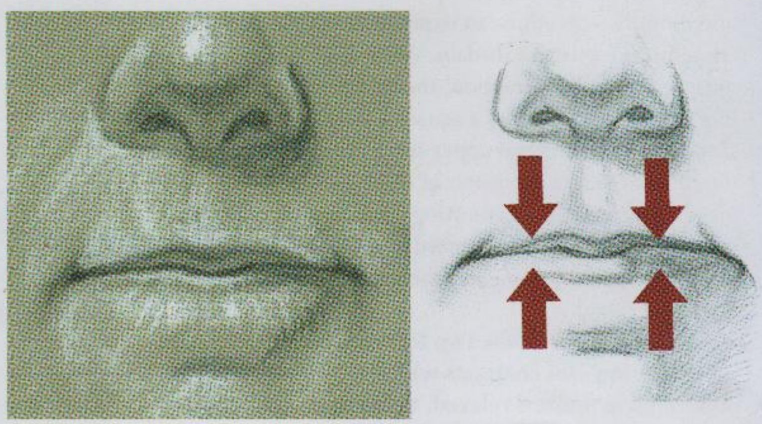
ACTION OF THE MUSCLE

When the orbicularis oris contracts slightly, the lip portion closes the lips gently. In a more forceful contraction, the muscle will compress the lips tightly together. The orbicularis oris can also draw the lips into a pucker for whistling or kissing. The puckering action, also known as "pursing the lips," is sometimes credited to small muscles, called the *incisive labii superioris* and *incisive labii inferioris*, which are positioned underneath the orbicularis oris. (Neither is shown here.)

The action of the lips is influenced not only by the orbicularis oris but by the contraction of the many muscles that anchor into the disc-shaped muscle of the mouth. These muscles help form the lips' different positions, which contribute essentially to our ability to produce sounds during speech and vocalization. For animation artists who must make their characters speak, it is helpful to understand the basic dynamics of the orbicularis oris and those of the other facial muscles that contribute to mouth movements and expressions.



Puckers the lips



Compresses the lips tightly

ORBICULARIS ORIS—ACTION OF MUSCLE

Levator Labii Superioris

PRONOUNCIATION
LEV-uh-tor LAY-bee-eye soo-PEER-ee-OR-iss
or
leh-VAH-tor lay-bee-eye soo-PEER-ee-or-iss

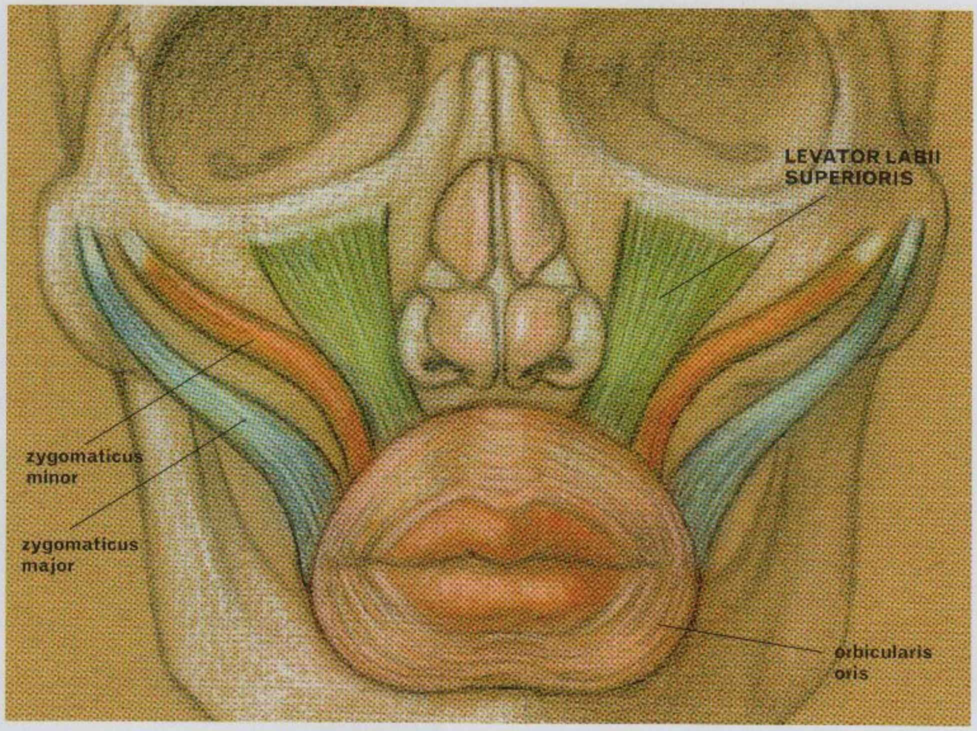
ORIGIN OF THE TERM
Latin *levator* = a raiser or lifter + *labium* = lip + *superioris* = above

SYNONYMS
musculus levator labii superioris (TA), infraorbital head of the quadratus labii superioris muscle group, lateral head of the levator labii superioris, levator labii superioris proprius, caput infraorbitale quadrati labii superioris

LEVATOR LABII SUPERIORIS—MUSCLE ATTACHMENTS

ORIGIN
■ lower border of orbit on zygomatic and maxilla bones

INSERTION
■ skin and muscle (orbicularis oris) of upper lip



LEVATOR LABII SUPERIORIS MUSCLE
With orbicularis oris and zygomaticus major and zygomaticus minor

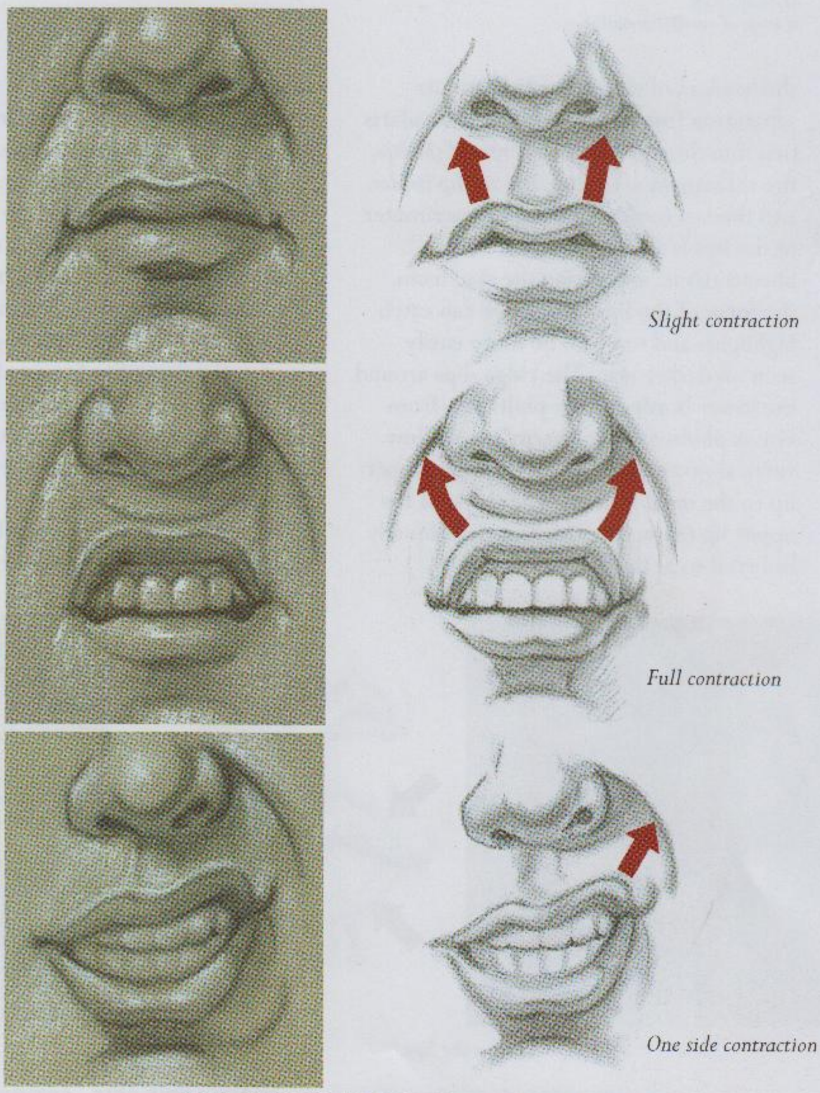
Levator Labii Superioris

The levator labii superioris elevates the upper lip. This quadrilateral muscle is positioned between the lower border of the eye socket and the orbicularis oris and between the levator labii superioris alaeque nasi (LLSAN) and the zygomaticus minor muscle.

ACTION OF THE MUSCLE

When the levator labii superioris muscle contracts slightly, it lifts the upper lip, stretching the upper lip and philtrum horizontally to produce an expression of contempt, disgust, or disdain. When the muscle is in full contraction, the upper lip lifts straight up, creating a squared-arch shape and exposing the upper teeth. This, too, produces an expression of disgust (or may be a precursor to vomiting). A long horizontal fold curving upward appears on the philtrum region, and the nasolabial furrow is raised.

When only one of the two levator labii superioris muscles contracts while the other muscle remains relaxed, the upper lip is pulled up on only one side, giving the face a snarling or sneering expression.



LEVATOR LABII SUPERIORIS—ACTION OF MUSCLE

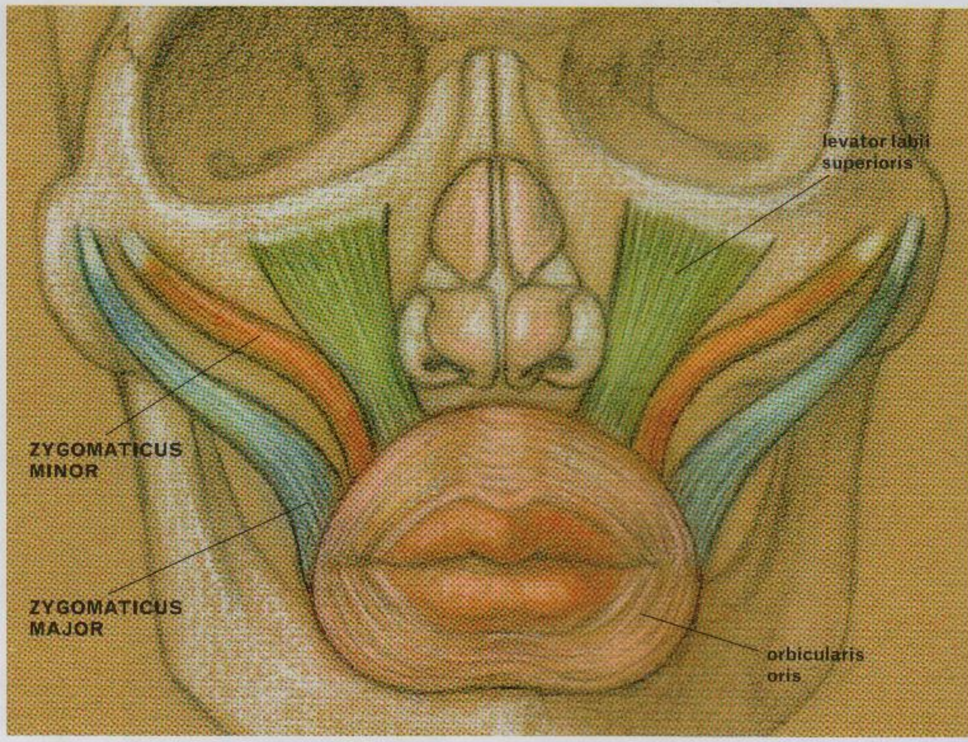
Zygomaticus Major and Zygomaticus Minor

PRONOUNCIATION
zigh-go-MAT-ick-us
or
zigh-go-MAT-ik-kus

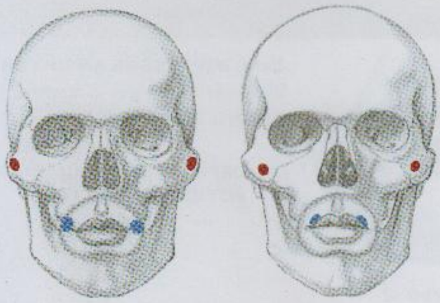
ORIGIN OF THE TERM
Greek *zygoma* = yoke +
Latin *major* = greater
and Latin *minor* = lesser

SYNONYMS
for zygomaticus major:
musculus zygomaticus major (TA), greater zygomaticus, smile muscle;

for zygomaticus minor:
musculus zygomaticus minor (TA), lesser zygomaticus, zygomatic head of the quadratus labii superioris muscle group, caput zygomaticus



ZYGOMATICUS MAJOR AND MINOR
With levator labii superioris and orbicularis oris



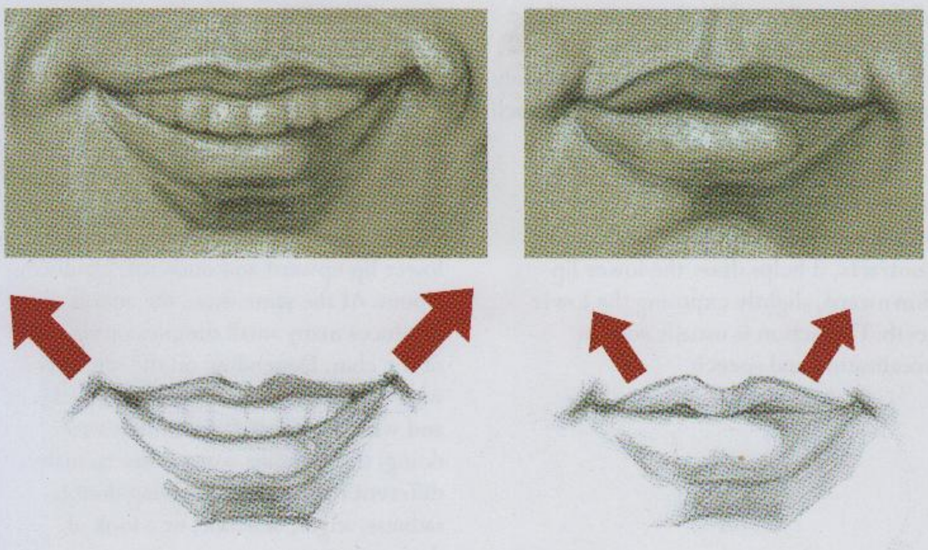
ZYGOMATICUS MAJOR AND MINOR—MUSCLE ATTACHMENTS

ORIGIN OF ZYGOMATICUS MAJOR
■ zygomatic bone (lateral aspect)

INSERTION OF ZYGOMATICUS MAJOR
■ angle of mouth (modiolus)

ORIGIN OF ZYGOMATICUS MINOR
■ zygomatic bone (anterior aspect)

INSERTION OF ZYGOMATICUS MINOR
■ skin of upper lip (medial corner of mouth)



Zygomaticus major contracting

Zygomaticus minor contracting

ZYGOMATICUS MAJOR AND MINOR—ACTION OF MUSCLES

Zygomaticus Major and Zygomaticus Minor

The zygomaticus major and zygomaticus minor muscles are, respectively, the larger and smaller muscles of the cheekbone.

The zygomaticus major muscle is an elongated muscular strip that begins at the cheekbone and obliquely inserts into the corners of the mouth (modiolus). The position of the zygomaticus major provides a transition between the planes of the side of the head and the front of the face.

The zygomaticus minor is a small, thin muscular strip beginning at the cheekbone and curving downward to insert into the skin of the upper lip. Some experts do not recognize the zygomaticus minor as an individual muscle but see it as the *zygomatic head of the quadratus labii superioris muscle group.*

ACTION OF THE MUSCLES

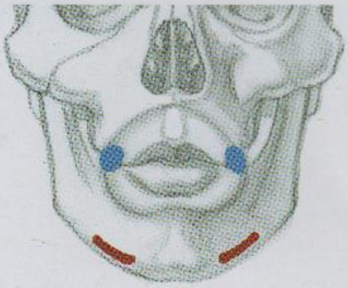
When the zygomaticus major muscle contracts, it elevates the corners of the mouth to produce the expression of smiling. The zygomaticus minor also helps elevate the corners of the mouth. In pulling the upper lip upward and outward, these muscles cause the nasolabial furrow to become more pronounced.

Depressor Anguli Oris

PRONOUNCIATION
dee-PRESS-or ANG-yoo-lie OR-iss
or
dee-PREH-sor AN-gyoo-lee OR-iss

ORIGIN OF THE TERM
Latin *deprimere* = to press down + *anguli* = of angles + *oris* = of the mouth

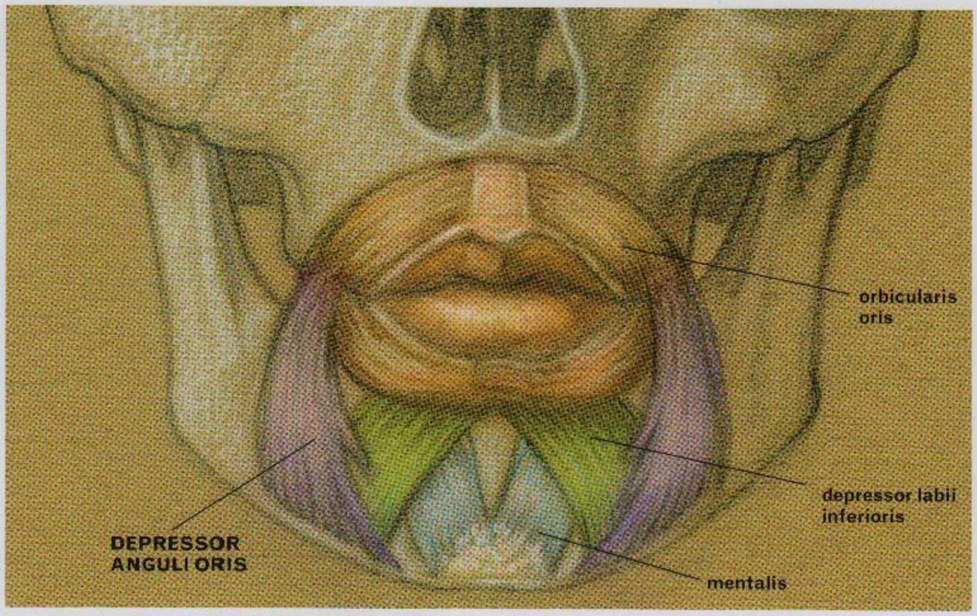
SYNONYMS
musculus depressor anguli oris (TA), triangularis, triangularis menti

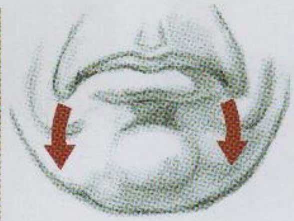


DEPRESSOR ANGULI ORIS—MUSCLE ATTACHMENTS

ORIGIN
- body of mandible, near lower border

INSERTION
- skin and orbicularis oris at corner of mouth (modiolus)





Depresses corner of mouth downward

Above: **DEPRESSOR ANGULI ORIS**
With orbicularis oris, depressor labii inferioris, and mentalis

Left: **DEPRESSOR ANGULI ORIS—ACTION OF MUSCLE**

Depressor Anguli Oris

The depressor anguli oris presses down the angle of the mouth (modiolus). This triangular muscle begins on the lower border of the jawbone (mandible) and converges to insert into the angle of the mouth. Its insertion is at the modiolus below the insertion of the zygomatic major muscle.

ACTION OF THE MUSCLE

When the depressor anguli oris muscle contracts, it draws the corners of the mouth downward, producing downward folds around the corners of the mouth, as in a grimace or an expression of sadness or disapproval. It is the antagonist to the zygomatic major muscle, which, in opposition, draws the corners of the mouth upward, as in a smile.

Depressor Labii Inferioris

The depressor labii inferioris draws the lower lip downward. This small, quadrilateral muscle begins on the lower jaw (mandible) and inserts into the skin of the lower lip and the lower area of the orbicularis oris muscle. The two parts of the paired muscle are positioned obliquely on the jaw and their fibers blend with each other near their point of insertion.

ACTION OF THE MUSCLE

When the depressor labii inferioris contracts, it helps draw the lower lip downward, slightly exposing the lower teeth. This action is usually seen in vocalization and speech.

Mentalis

The mentalis is a paired V-shaped muscle located in the chin region. This muscle contributes to fleshing out the bony part of the chin, giving the region an oval shape. Sometimes a single large dimple or cleft will appear in the center of the chin even when the mentalis muscle is relaxed.

ACTION OF THE MUSCLE

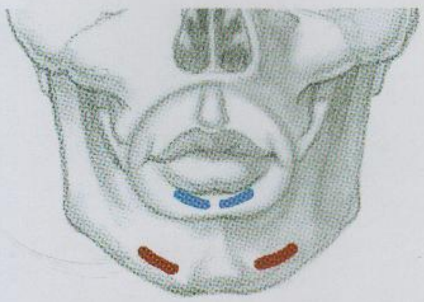
When the mentalis muscle contracts, it pulls the skin of the chin upward, lifting the chin mass. This action pushes the lower lip upward and outward, producing a pout. At the same time, the action produces many small dimples on the skin of the chin. Depending on the intensity with which the lower lip is protruded and what the other facial muscles are doing, the mentalis contributes to many different expressions, showing doubt, sadness, anger, defiance, or a look of determination.

Depressor Labii Inferoris

PRONOUNCIATION
dee-PRESS-or LAY-bee-eye in-FEAR-ee-or-iss
or
dee-PREH-sor lay-bee-eye in-FEAR-ee-OR-iss

ORIGIN OF THE TERM
Latin *deprimere* = to press down + *labium* = lip + *inferioris* = lower, below

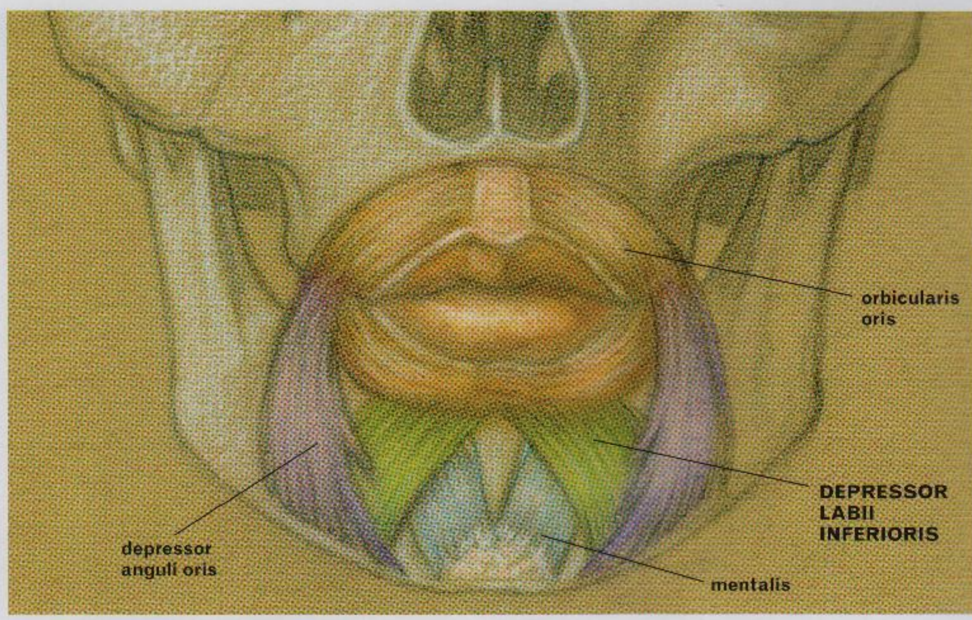
SYNONYMS
musculus depressor labii inferioris (TA), quadratus menti, quadratus labii inferioris, depressor of the lower lip



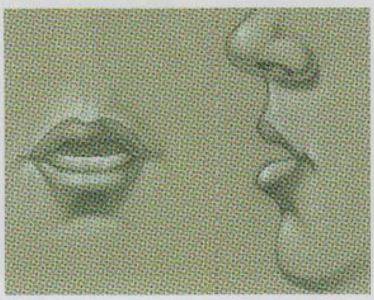
DEPRESSOR LABII INFERIORIS—MUSCLE ATTACHMENTS

ORIGIN
- body of mandible

INSERTION
- skin of lower lip and orbicularis oris muscle



DEPRESSOR LABII INFERIORIS MUSCLE
With orbicularis oris, depressor anguli oris, and mentalis



Depresses lower lip downward

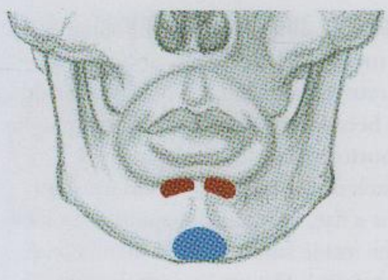
DEPRESSOR LABII INFERIORIS—ACTION OF MUSCLE

Mentalis

PRONOUNCIATION
men-TAL-iss
or
men-TAY-liss

ORIGIN OF THE TERM
Latin *mentum* = chin

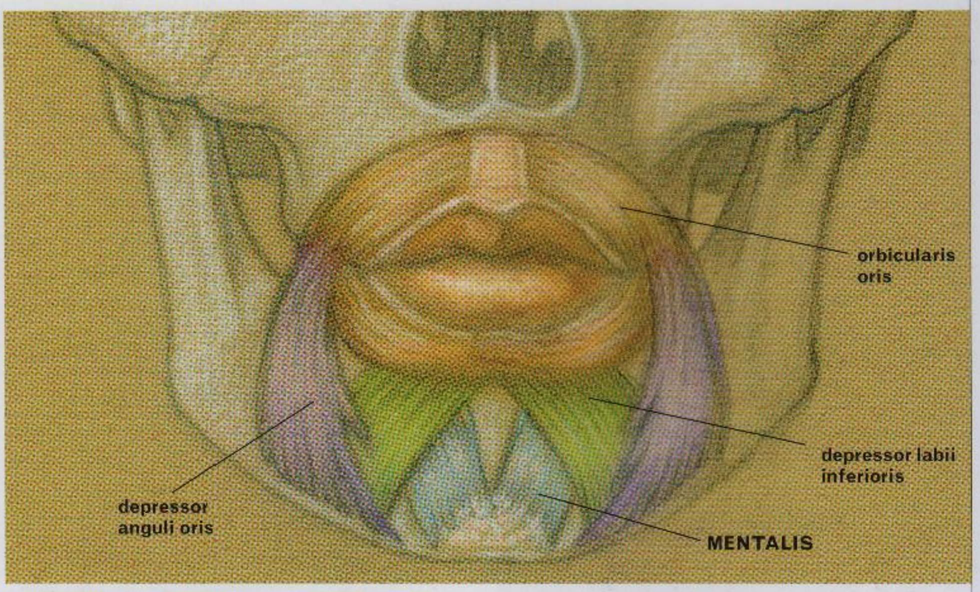
SYNONYMS
musculus mentalis (TA), levator menti, levator labii inferioris



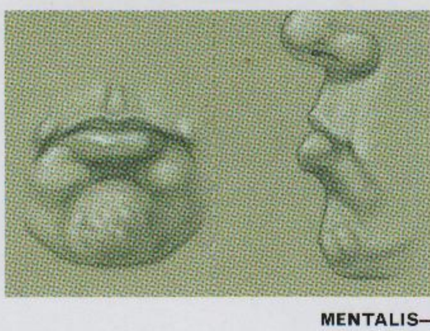
MENTALIS—MUSCLE ATTACHMENTS

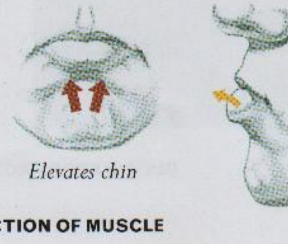
ORIGIN
- mandible, below lower incisor teeth

INSERTION
- into skin of chin



MENTALIS
With orbicularis oris, depressor anguli oris, and depressor labii inferioris





Elevates chin

Makes lower lip protrude

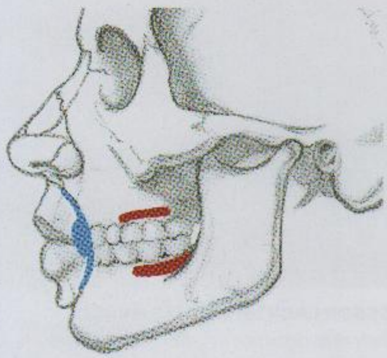
MENTALIS—ACTION OF MUSCLE

Buccinator

PRONOUNCIATION
BUCK-sin-NAY-tor
or
BUCK-sih-NAY-tor

ORIGIN OF THE TERM
Latin *bucina* = trumpet

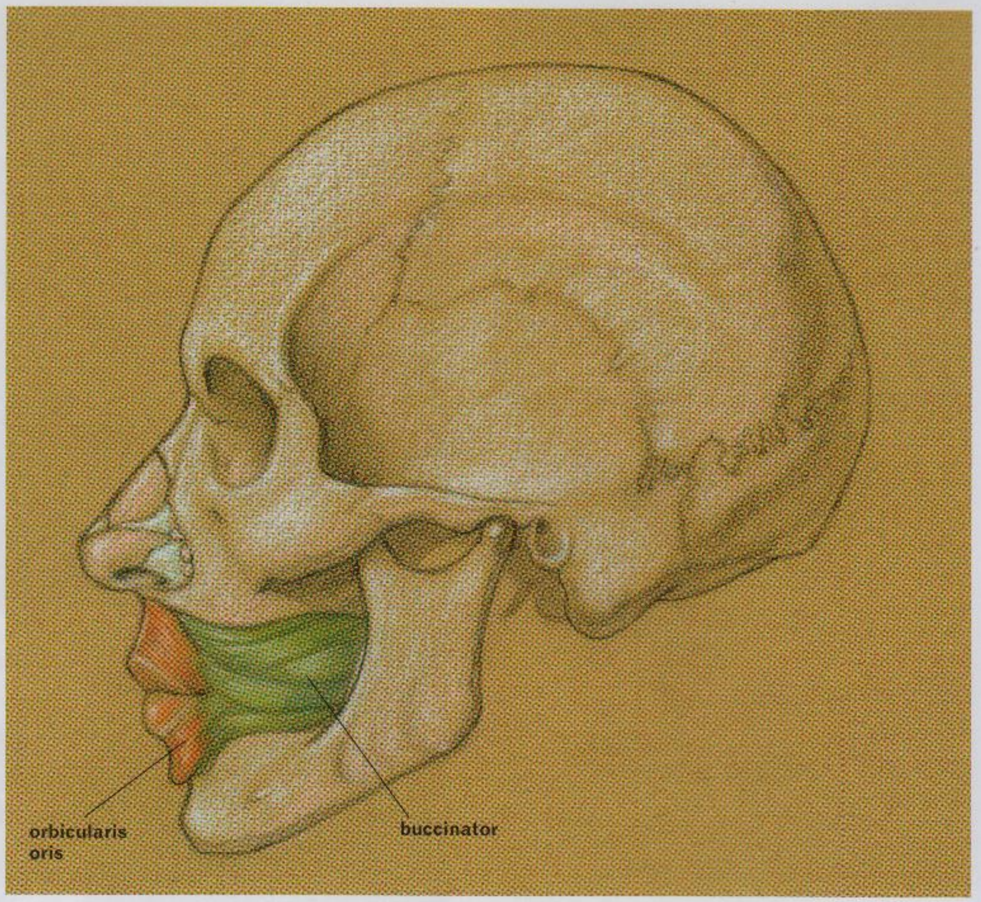
SYNONYMS
musculus buccinator (TA),
trumpeter's muscle



BUCCINATOR—MUSCLE ATTACHMENTS

ORIGIN
- maxilla, in region of first and second molars
- mandible, in region of first and second molars
- pterygo-mandibular raphe

INSERTION
- orbicularis oris
- angle of mouth (modiolus)



BUCCINATOR
With orbicularis oris

Buccinator

The buccinator is a flat, horizontal muscle that forms the muscular wall of the cheek. It begins near the first and second molars on both the maxilla and the mandible. The fibers also originate from the *pterygo-mandibular raphe,* which is a tendinous band from another muscle that is positioned behind the mandible. The buccinator inserts into the orbicularis oris muscle near the angle of the mouth and the modiolus with a crisscrossing of fibers. Some of its lower fibers attach near the upper portion of the lip while the upper fibers attach near the lower portion of the lip. The masseter muscle partially covers the buccinator.

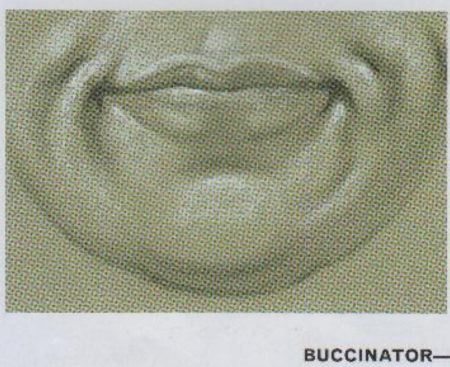
ACTION OF THE MUSCLE

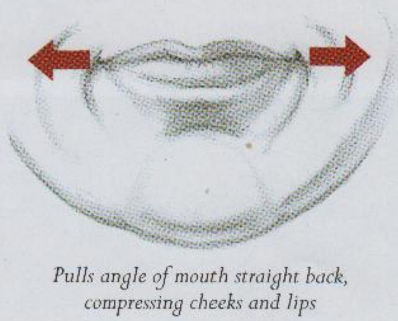
When the buccinator contracts, it pulls the lips tightly across the teeth and draws the angles of the mouth straight back, creating dimples around the outside corners of the mouth. It also compresses the cheeks against the teeth, as in the action of drawing fluids through a straw. The buccinator helps resist distention when blowing or expelling air through the lips. Musicians of wind and brass instruments utilize this muscle, along with the orbicularis oris muscle, to train the lips to decrease and increase tension, which is a determining factor in controlling pitch. (This is why the buccinator is often called the trumpeter's muscle.) The contraction of this muscle also produces expressions of contempt, annoyance, and smirking.

Mylohyoid and Digastric Muscles

The mylohyoid and digastric are two separate muscles but are grouped together here because of their close overlapping in the bottom plane of the jaw.

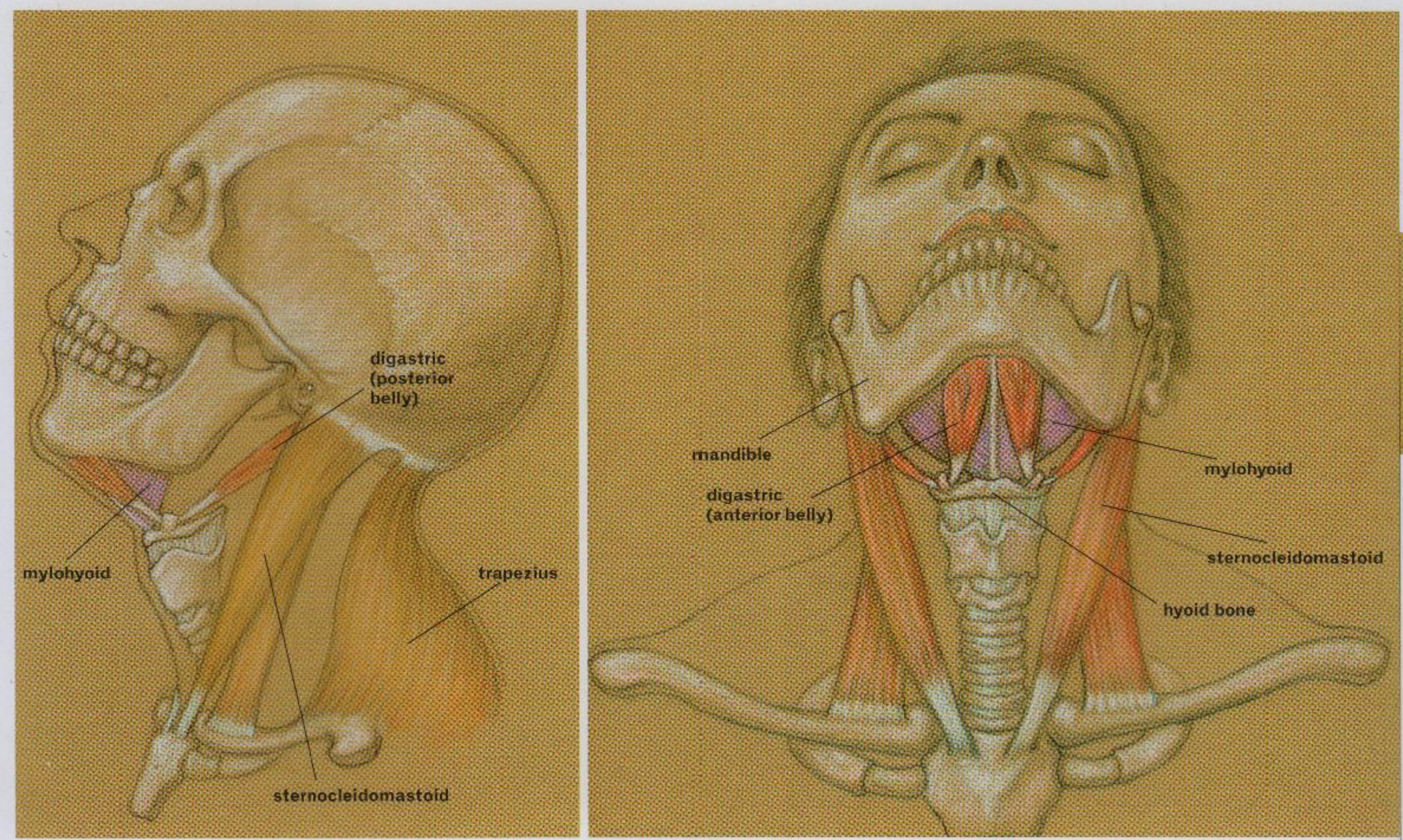
Each of the two mylohyoid muscles forms a flat, triangular shape that attaches on the inside surface of the mandible. It inserts into a fibrous line (the *mylohyoid raphe*) that extends from the inside area of the chin (on the jaw) to the hyoid bone, the U-shaped bone of the neck. The mylohyoid acts like a sling that forms the floor of the mouth; with the digastric muscle, fatty tissue, and glands, it helps flesh out the bottom plane of the jaw.





Pulls angle of mouth straight back, compressing cheeks and lips

BUCCINATOR—ACTION OF MUSCLE



MYLOHYOID AND DIGASTRIC MUSCLES
With sternocleidomastoid and trapezius. Left: Lateral view. Right: Anterior view.

The digastric muscle is a two-bellied muscle in the region of the lower plane of the jaw. The anterior (front) belly is larger and thicker than the posterior (back) belly, which is thin and long. The anterior belly attaches to the inside margin of the mandible near the chin region. The posterior belly attaches to the mastoid notch at the medial side of the mastoid process of the cranium. The tendon between these two bellies inserts into the hyoid bone by a fibrous loop sometimes referred as the *sling of the digastric*. The digastric muscle is positioned on top of the mylohyoid muscle.

ACTION OF THE MUSCLES

The mylohyoid and digastric muscles help lower (depress) the mandible, especially in the action of opening the mouth wide, as in a yawn. The muscles also elevate the hyoid bone during swallowing and speaking.

Mylohyoid

PRONOUNCIATION
MY-lo-HI-oid

ORIGIN OF THE TERM
Greek *myle* = molar tooth + *hyoid* = U-shaped

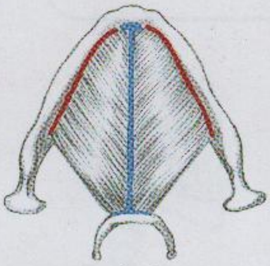
SYNONYM
musculus mylohyoideus (TA)

Digastric Muscle

PRONOUNCIATION
die-GAS-trick

ORIGIN OF THE TERM
Greek *di* = two + *gaster* = of or relating to the belly

SYNONYMS
musculus digastricus (TA), digastricus, biventer mandibulae



Mylohyoid (inferior view of mandible)

Digastric (inferior view of cranium)

MYLOHYOID AND DIGASTRIC—MUSCLE ATTACHMENTS

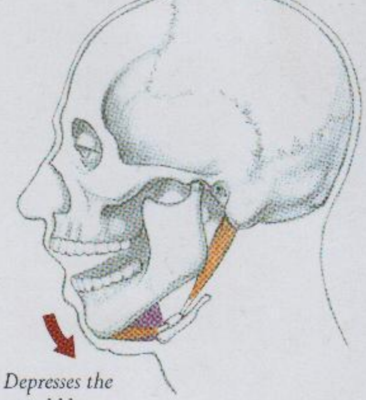
ORIGIN OF MYLOHYOID MUSCLE
- inner surface of body of mandible

INSERTION OF MYLOHYOID MUSCLE
- into a fibrous line that attaches from inside chin region of mandible to hyoid bone

ORIGIN OF DIGASTRIC MUSCLE (ANTERIOR BELLY)
- digastric fossa on lower inside of mandible

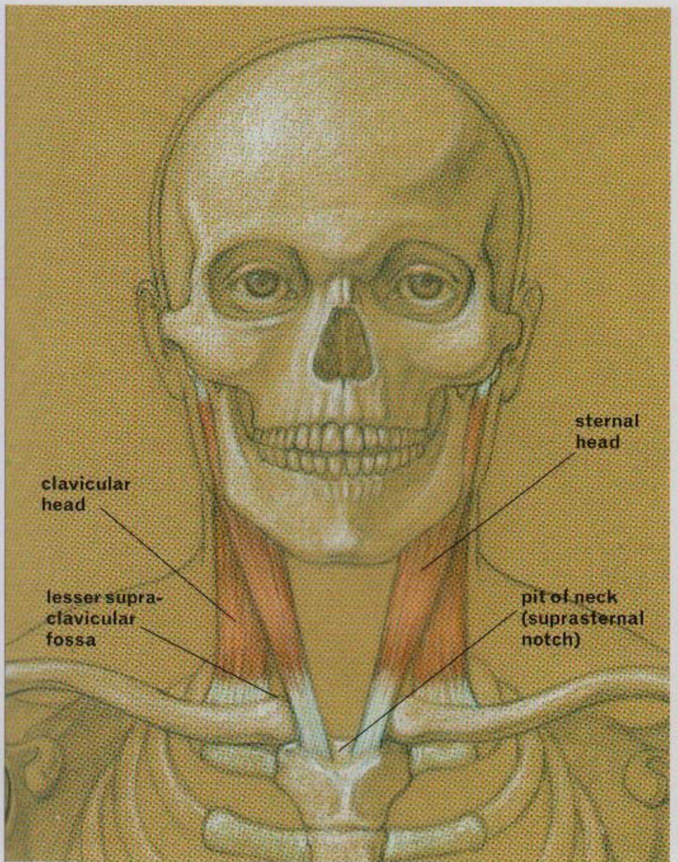
ORIGIN OF DIGASTRIC MUSCLE (POSTERIOR BELLY)
- cranium (mastoid notch, near mastoid process)

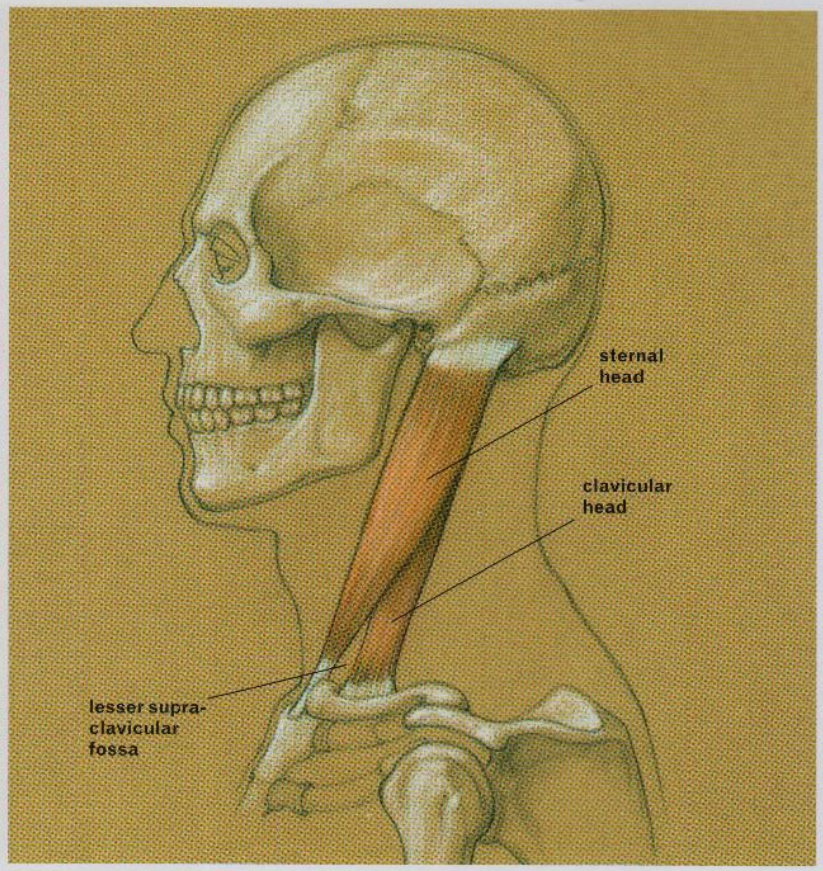
INSERTION OF DIGASTRIC MUSCLE (BOTH BELLIES)
- hyoid bone (by a tendon)



Depresses the mandible

MYLOHYOID AND DIGASTRIC—ACTION OF MUSCLES





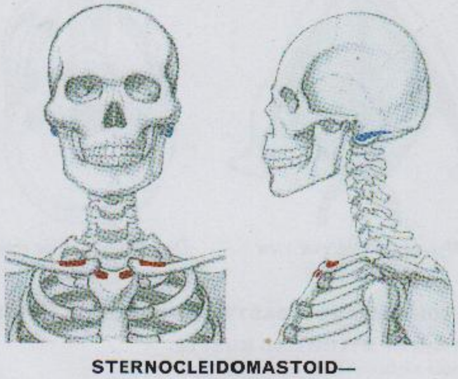
STERNOCLEIDOMASTOID
Left: Anterior view. Right: Lateral view.

Sternocleidomastoid

PRONOUNCIATION
STIR-no-KLIE-doe-MASS-toid

ORIGIN OF THE TERM
Greek *sternon* = chest + *cleis* = resembling a key + *mastoid* = breastlike

SYNONYMS
musculus sternocleidomastoideus (TA), sternomastoid, SCM



STERNOCLEIDOMASTOID—MUSCLE ATTACHMENTS

ORIGIN (STERNAL HEAD)
- sternum (anterior surface of manubrium)

ORIGIN (CLAVICULAR HEAD)
- clavicle (inner medial third)

INSERTION
- mastoid process of cranium
- superior nuchal line of occipital bone (base of cranium)

Sternocleidomastoid

The sternocleidomastoid consists of two separate straps of muscle on either side of the neck form. Each of these straps has two heads:

- The *sternal head* (also called the *sternal portion* or *medial head*)
- The *clavicular head* (also called the *clavicular portion* or *lateral head*)

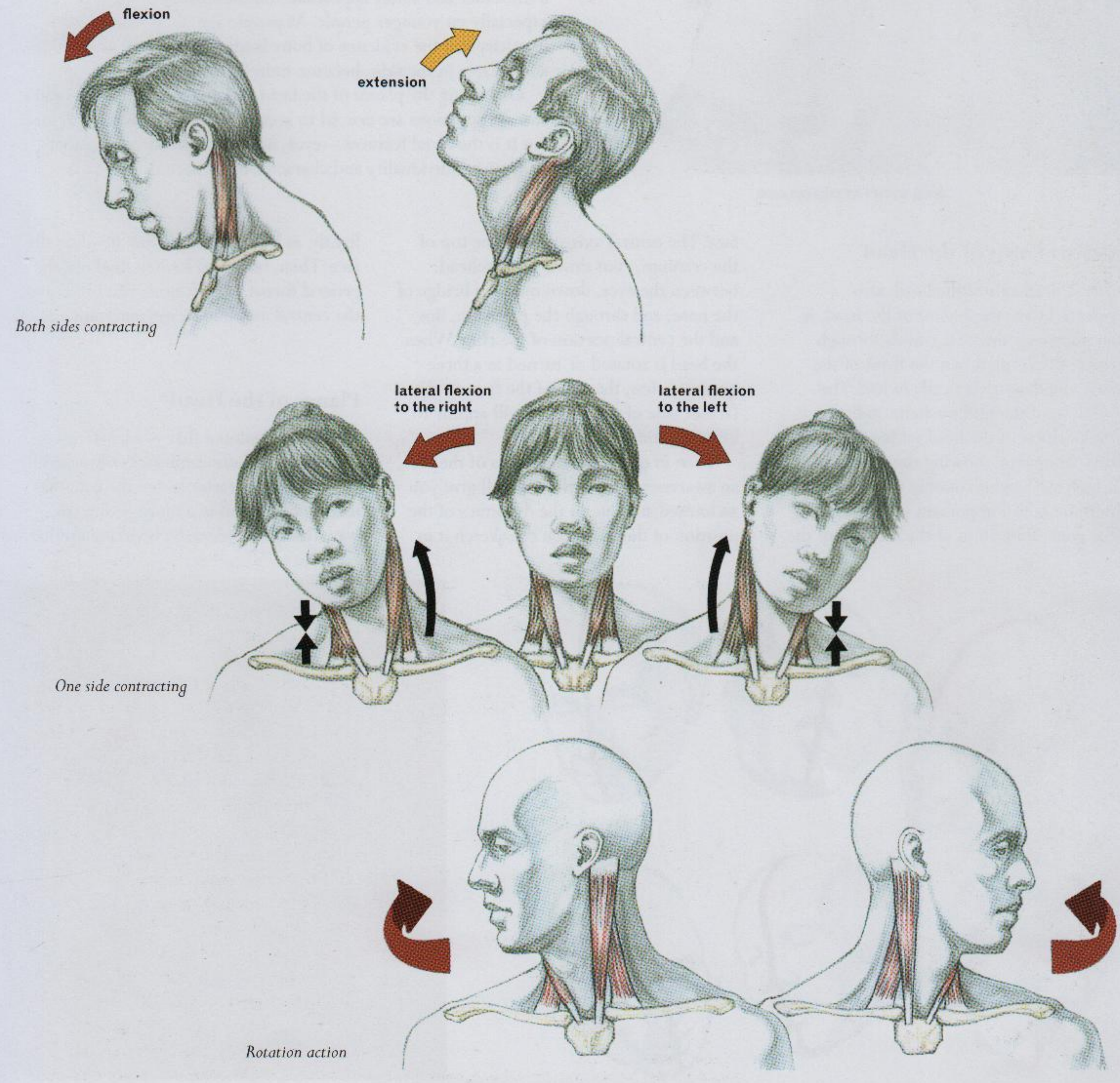
The sternal head has a tapered, cordlike tendon that attaches on the upper portion of the sternum (breastbone). The tendon of the clavicular head is broad and flat and attaches on the clavicle (collarbone). The extremely small triangular space between these two tendons (near the clavicle) is called the *lesser supra-clavicular fossa.* It is sometimes possible to see this on the surface form, but it is the tendons of the sternal heads that are usually most noticeable in this region. The tendons of the sternal heads have a small space between them as they attach into the manubrium (upper portion of the sternum). This space is technically referred to as the *suprasternal notch* but is more commonly known as the *pit of the neck*. It is a convenient landmark because it is located at the intersection of the clavicles and the sternum and serves as a pivot point for the neck in certain action poses. The tapered tendons of the sternal heads generally pop out when the head is turned or tilted. The clavicular heads are subtler and more difficult to locate, but their position indicates the outer borders of the cylindrical form of the neck.

The fleshy muscular fibers of the sternocleidomastoid begin to move obliquely upward toward the portion of the skull behind the ear. Midway, the two heads merge into a single muscular mass that is thick and wide. The common tendon at this end inserts into the mastoid process of the temporal bone and the superior nuchal line of the occipital bone of the skull.

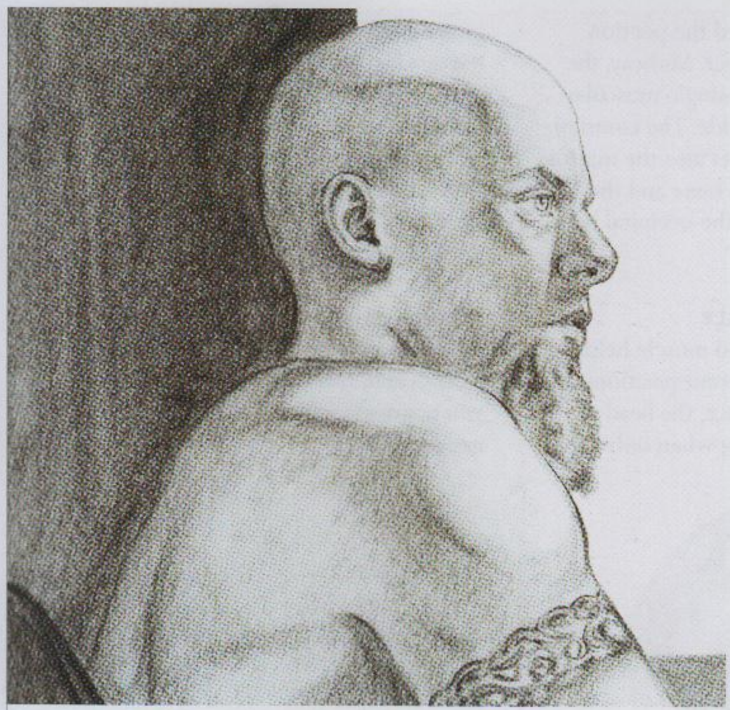
ACTION OF THE MUSCLE

The sternocleidomastoid muscle helps bend the head into different positions. When both sides contract, the head bends forward (flexion); when only the posterior fibers (on both sides) contract, the head is moved up and back. When only one side contracts, the head is brought closer to the shoulder on the side of the contracting muscle (lateral flexion). And, with the help of other muscles, the sternocleidomastoid swivels (pivots, or rotates) the head from side to side.

When drawing the neck, observe carefully to see whether any stretching or compression is visible in the sternocleidomastoid; this will help you convey tension or action in the neck region.



STERNOCLEIDOMASTOID—ACTION OF MUSCLES



MAN WITH TATTOO ON ARM

The Structure and Surface Forms of the Head, Face, and Neck

In the final pages of this chapter, we turn our attention to the head's surface appearance, including its planes and proportions and the basic structure of the facial features. As previously mentioned, the muscles of the face are difficult to detect on the surface because they are covered over by soft-tissue forms such as skin, fascia, fatty tissue, and glands. These forms create a smoother and softer appearance on the surface of the face, especially on younger people. As people age, their skin loses elasticity and the evidence of bony landmarks, as well as wrinkles and creases in the skin, become more predominant.

Observing the planes of the head and understanding the head's basic proportions are crucial to accurately conveying its structure, but it is the facial features—eyes, nose, mouth, and ears—that truly give individuality and character to the face.

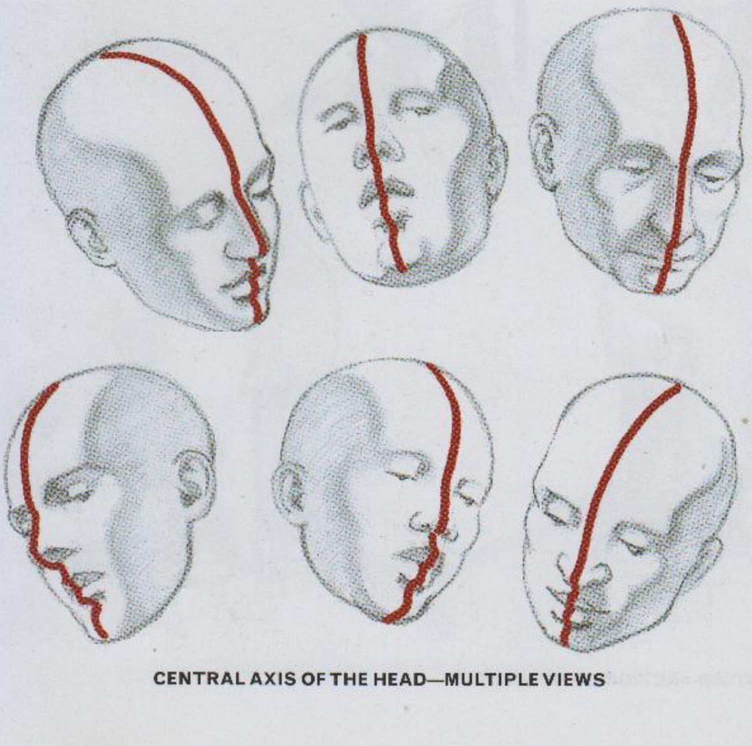
Central Axis of the Head

The central axis of the head, also referred to as the *midline* of the head, is an imaginary line that travels through the entire head, down the front of the face, dividing it vertically in half. The location of the midline helps indicate the position of the head within the space it is occupying, showing the degree to which the head is rotating or tilting. The midline is also important in determining the general location of the features of the face. The central axis starts at the top of the cranium, runs down the forehead, between the eyes, down over the bridge of the nose, and through the philtrum, lips, and the central portion of the chin. When the head is rotated or turned in a three-quarters view, the side of the face on the farther side of the midline will appear to be more condensed.

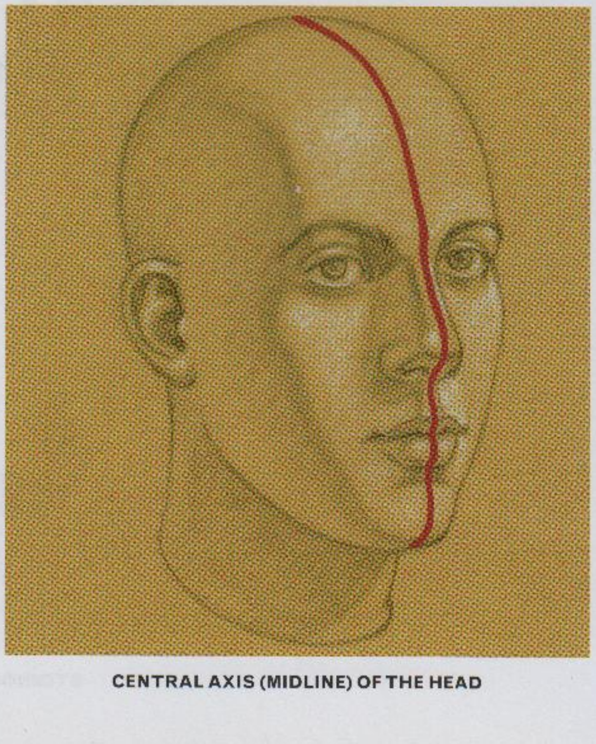
Even in quick action studies of the face, an awareness of the midline will give you an immediate clue to the dynamics of the position of the head. You can sketch it in lightly, as a quick, simple line dividing the face. Then, once you have fleshed out the general forms and features, you can erase the central axis line from your study.

Planes of the Head

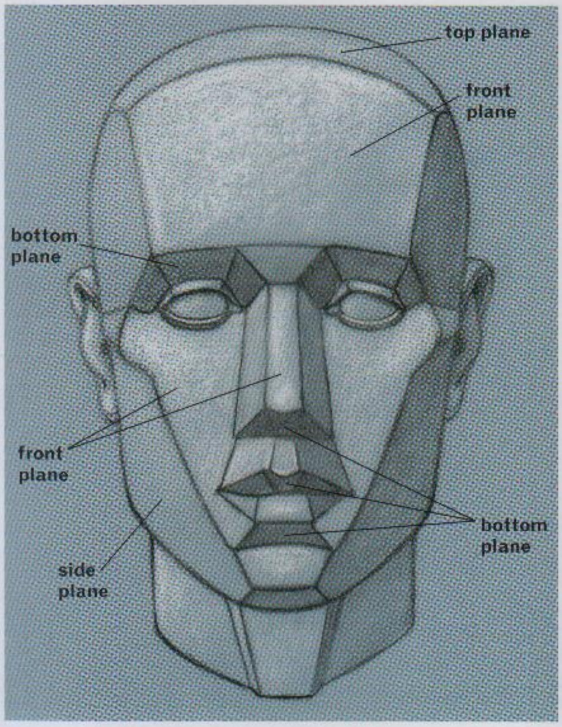
While it is essential that you learn to recognize the bony landmarks of the skull, it is sometimes easier to see the general forms of the head in a more geometric way. This can be done by breaking up the

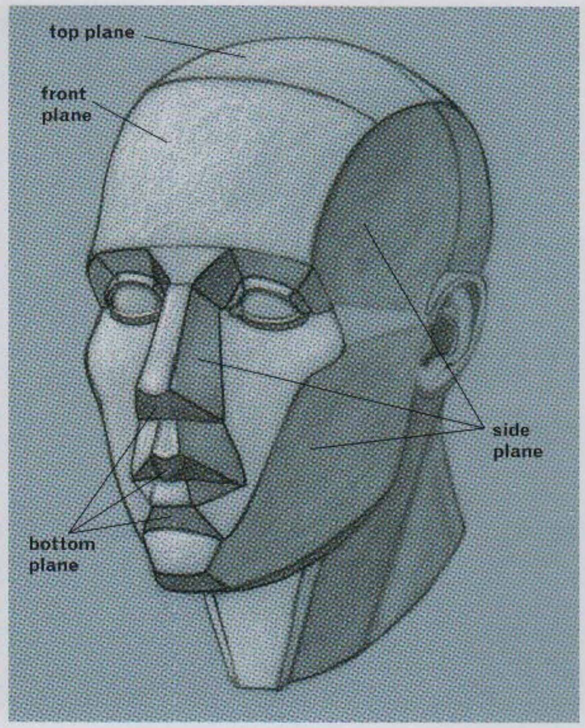


CENTRAL AXIS OF THE HEAD—MULTIPLE VIEWS



CENTRAL AXIS (MIDLINE) OF THE HEAD





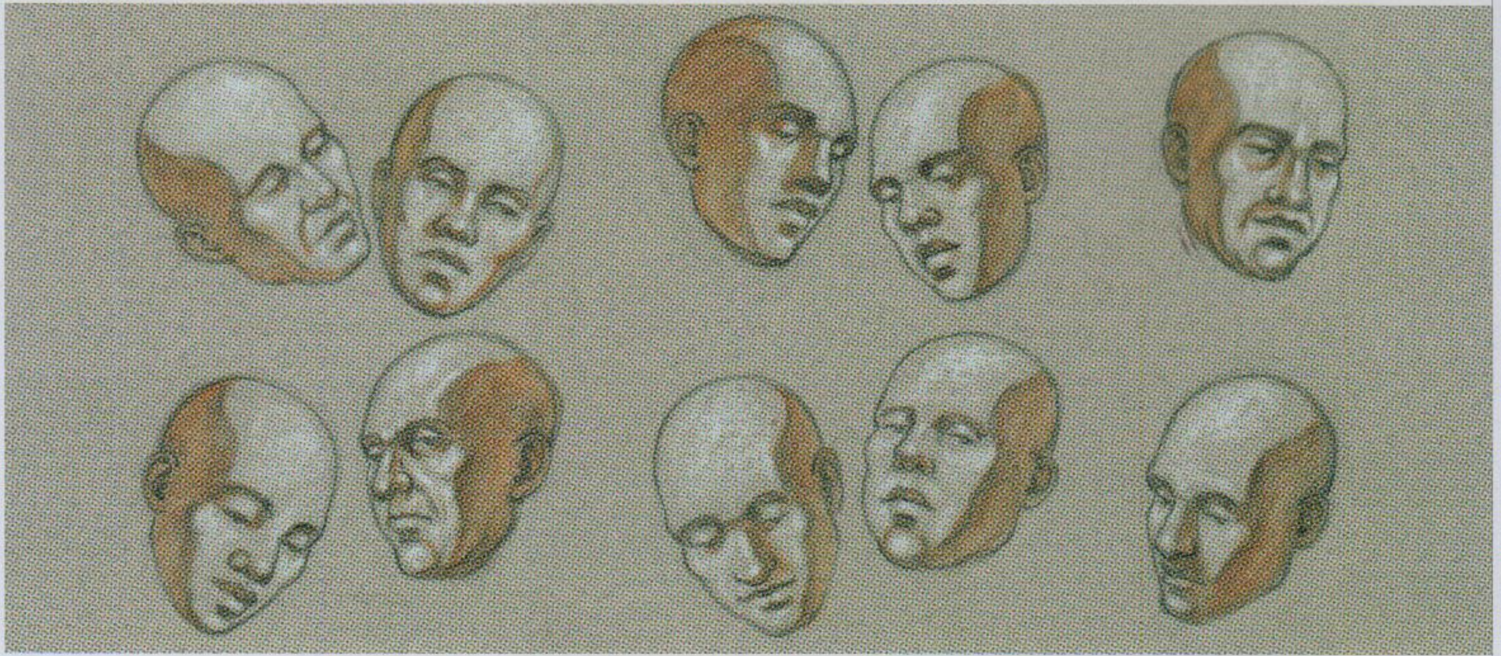
PLANES OF THE HEAD
Left: Anterior view.
Right: Three-quarters view.

various areas of the face into a system of planes. You will find that drawing the planes of the head—which gives your rendering a chiseled, sculptural look— is a great way to quickly set down the general shapes of the face without getting immediately seduced by the intricate details of the features.

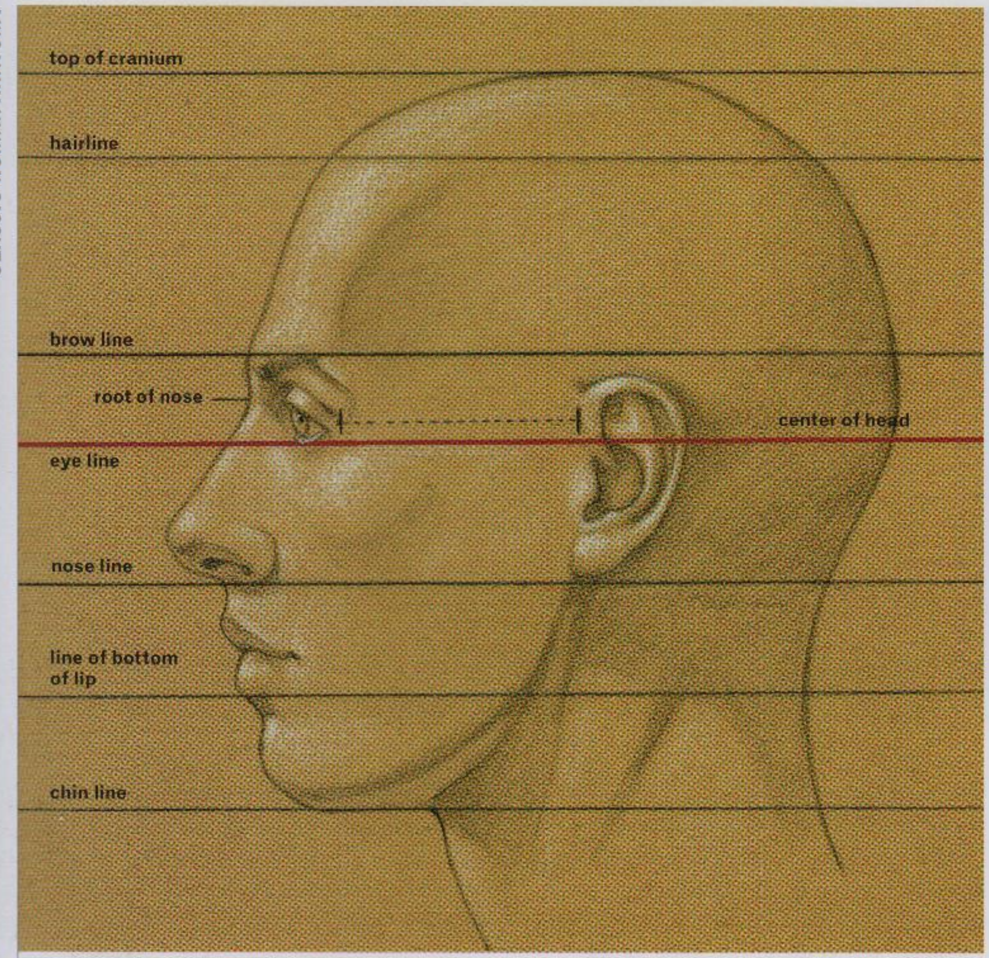
The head has four basic sets of planes: the *top planes,* the *front planes,* the *side planes,* and the *bottom planes* (although some artists prefer to focus on only the last three of these). On a live model, the planes are easier to see if the head is illuminated by a strong light source that produces obvious lights and shadows. The shadows tend to appear around the eyes in the sockets, at the sides and bottom of the nose, across the entire shape of the upper lip, at the little indentation beneath the lower lip, at the sides of the head from the temple lines and cheekbone borders, beneath the bottom plane of the jaw, and around the cylindrical from of the neck. Of course, these shadows will vary depending on the direction of the light and the angle and shape of the head. But once you have the basic planes in place, you can bring out the detail of the features and the many gradations of light and dark tones.

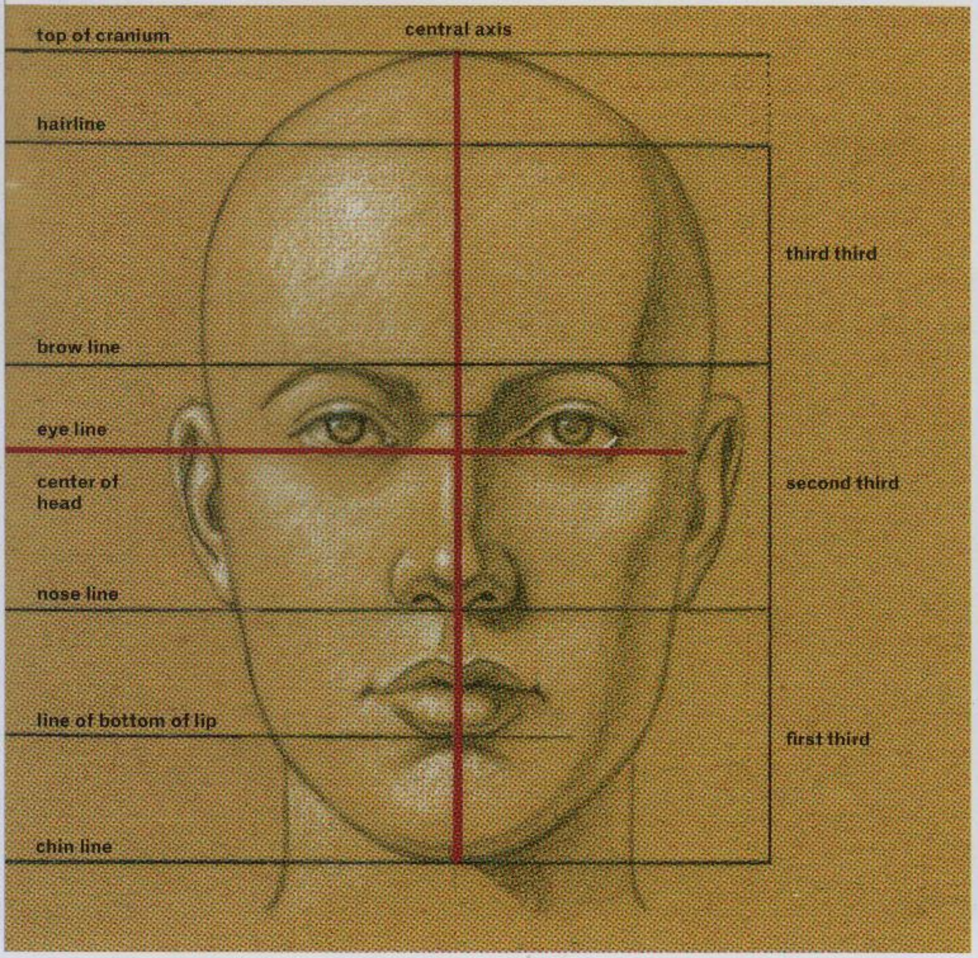
Proportions of the Head

Over the centuries, artists have developed several proportional systems, called *canons,* to be used as guides for measuring the human figure, including the head.



PLANES OF THE HEAD—MULTIPLE VIEWS





There are slight variations among the different canons, but the measurements of the head all relate to the locations of the skull landmarks and the approximate positions of the facial features. These measurements only work, however, if the head is viewed straightforwardly from the front or side and is not tilted dramatically or viewed in a foreshortened pose in which the head is leaning toward or away from the viewer.

Always keep in mind that the charts shown here should serve only as basic guides and that few people's heads and features will accord with these idealized standards. People's faces are unique and different in many subtle ways. Proportional canons can therefore help assist artists only in the *general* placement of the forms. With that caution in mind, here are the basic proportional breakdowns:

PLACEMENT OF THE EYES AND THE CENTER OF THE HEAD

In front, side, and three-quarter views (with no tilting that would alter perspective), the eyes are located approximately at the center of the head when measured from the chin to the top of the cranium. The *eye line,* which passes through the bottoms of the lids, will help you place the eyes in relation to the whole head, considered vertically. In a straight-on frontal view, the eyes are about the length of one eye apart from each other. Remembering this proportion will help you avoid placing the eyes too close to or far apart from each other.

THE "THIRDS" OF THE HEAD

The face can be divided vertically into three more or less equal portions called the *thirds of the head.* The formula, too, is helpful to remember, especially when drawing from memory. Working from the chin upward, the "thirds" are as follows:

- *First third*: From the chin line to the nose line (the bottom of the nose)
- *Second third*: From the nose line to the brow line (the top border of the brow ridge or eyebrows)

PROPORTIONS OF THE HEAD
Top: Lateral view
Bottom: Anterior view

- *Third third*: From the brow line to the hairline (the line that passes through the point at which the hair begins to grow at the midline, sometimes called the widow's peak)

When applying these three divisions, do not neglect to include the rest of the cranium, which sweeps away from the hairline toward the back of the skull.

PLACEMENT OF THE LIPS

To place the lips in approximately the correct location, divide the first (bottom) third in half and place the bottom edge of the lower lip on this line. This will keep the lips from sagging too low on the face.

PLACEMENT OF THE EARS

The ears are generally placed between the brow line and the nose line. Their exact position will vary, however, according to the individual—and will appear different if the head is leaning even slightly downward or upward. In profile, or lateral, views, the space between the placement of the ear and the outside corner of the eye is actually the same as the distance from the bottom to the top of one of the thirds. A quick way to check whether you have the interval correct is to measure the distance from the bottom of the chin up to the nose line and then to compare this with the distance from the outside corner of the eye to where the ear attaches on the scalp. Always check this particular measurement carefully, because many beginning artists tend to position the ear too far forward on the profile view of the head. Also note that the ear is positioned at a slight angle, in alignment with the short angle of the jaw.

ROOT OF NOSE, WIDTH OF NOSE

The root of the nose (the place at the top of the nose where it begins to project from the face) is approximately halfway between the eye line and the brow line. Observing this placement will help you avoid making the nose too short or too long. The width of the nose in a front view varies from person to person depending on the structure of his or her nasal cartilage. One way to check whether you have the width correct is to use the space between the eyes as a reference point for measuring. In front views, the wings of the nose will be approximately the same width as the space between the eyes—or slightly wider or slightly narrower, depending on the individual. It is, in fact, essential always to be comparing the placement of each facial form to the positions of other features to achieve the proper proportions when drawing the head.

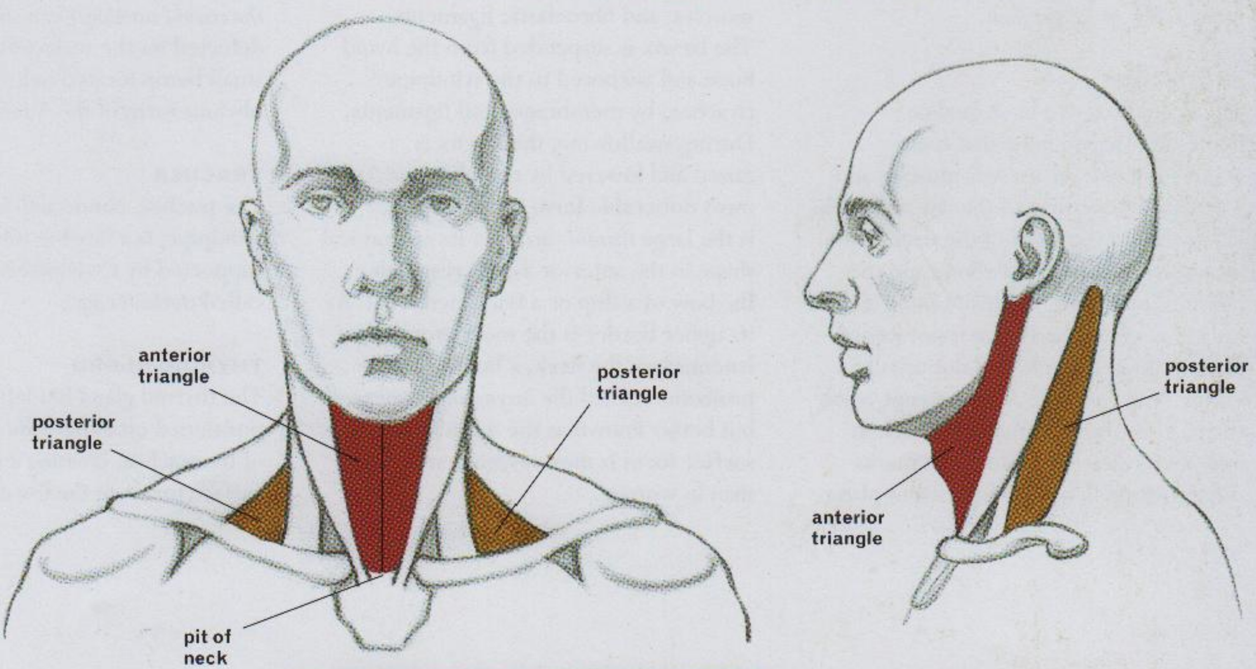
The Neck—Structures and Forms

The neck is an important form to consider when approaching the study of the head. Its cylindrical shape provides a solid support for the skull. When the head is tilting in different directions, the muscles on the neck tend to stretch and compress, which can give the pose an interesting quality. From a side view in a normal stance, the neck has a graceful curve that follows the curve of the cervical vertebrae.

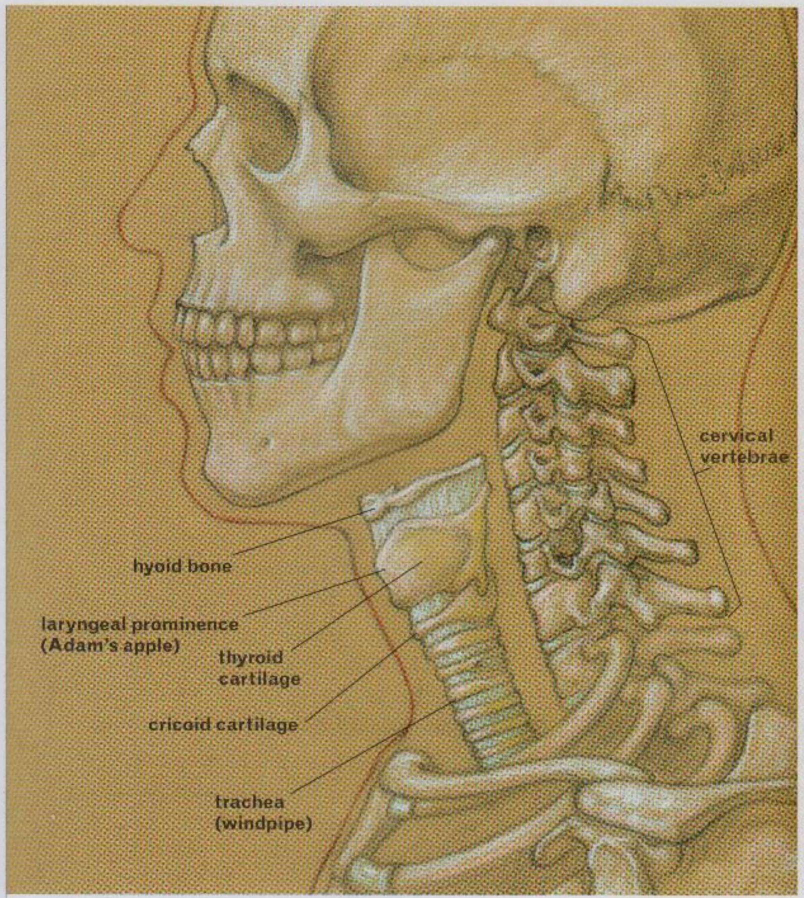
TRIANGLES OF THE NECK

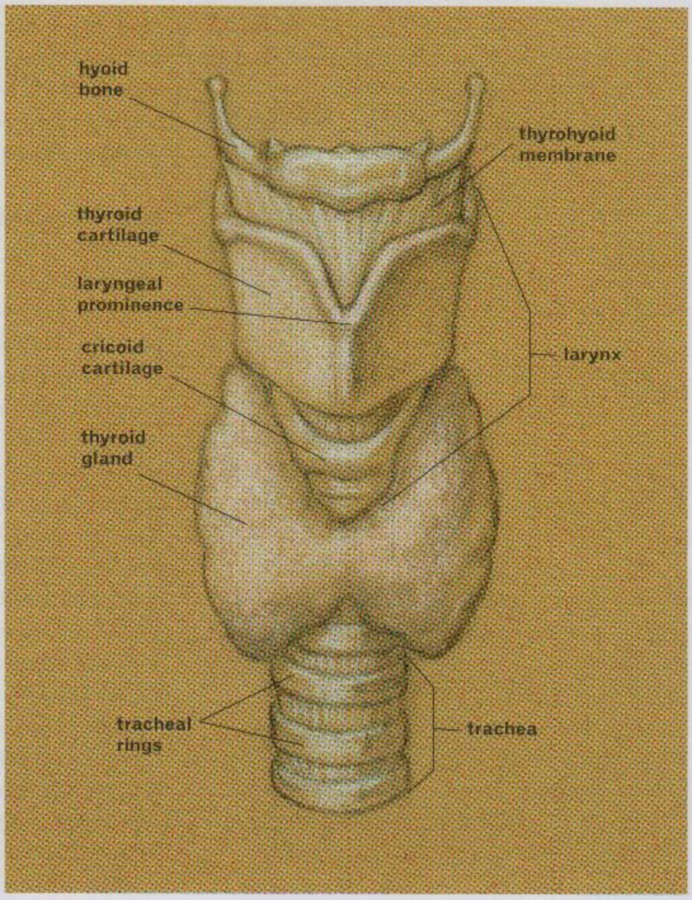
There are two large triangular spaces in the neck and shoulder region. The *anterior triangle* is in the front of the neck between the inner borders of the sternocleidomastoid muscles (the strap-like muscles on either side of the neck) and the bottom plane of the lower jaw. Within this triangle are the hyoid bone, the larynx (voice box), and the trachea (windpipe), as well as glands and various small muscles of the neck. In some anatomy books the anterior triangle is divided down the center along a line called the central axis of the neck.

The second triangular shape is called the *posterior triangle*. There are actually two posterior triangles, located in the shoulder region on either side of the neck. Each posterior triangle borders the outer edges of the sternocleidomastoid muscle and the inner border of the trapezius (shoulder muscle), with the clavicles serving as the lower border. This particular area is usually seen as a triangular depression in the shoulder region, especially when the shoulders are projected forward.



TRIANGLES OF THE NECK AND SHOULDER REGION
Left: Anterior view. Right: Lateral view.





STRUCTURES AND FORMS OF THE NECK

Left: Bones and cartilage (lateral view). Right: Hyoid bone, larynx, and trachea (anterior view).

At the base of the neck in the front view, there is a depression, or hollow, just above the breastbone (sternum) and between the collarbones (clavicles). This indentation is technically referred to as the *suprasternal notch,* but its common name is the *pit of the neck*.

HYOID BONE

The hyoid bone is a U-shaped or horseshoe-shaped bone that is an attachment site for various muscles and soft-tissue structures of the jaw and neck. Positioned in the front of the neck in an angle between the jawbone and the larynx (voice box), the hyoid bone is the only bone in the body that is not joined to other bones. While it is not usually visible on the surface form (except when the head is tilting dramatically back in hyperextension), its placement marks the transition between the bottom plane of the jaw and the cylindrical form of the neck.

LARYNX

The larynx, or voice box, consists of several cartilage structures, small muscles, and fibroelastic ligaments. The larynx is suspended from the hyoid bone and anchored to the windpipe (trachea) by membranes and ligaments. During swallowing, the larynx is raised and lowered by muscles. The most noticeable form in the larynx is the large *thyroid cartilage*. Its anatomical shape in the anterior aspect resembles the bow of a ship or a tricornered hat. At its upper border is the most prominent landmark of the neck, a bump-like projection called the *laryngeal prominence* but better known as the *Adam's apple*. Its surface form is more prominent in men than in women.

CRICOID CARTILAGE

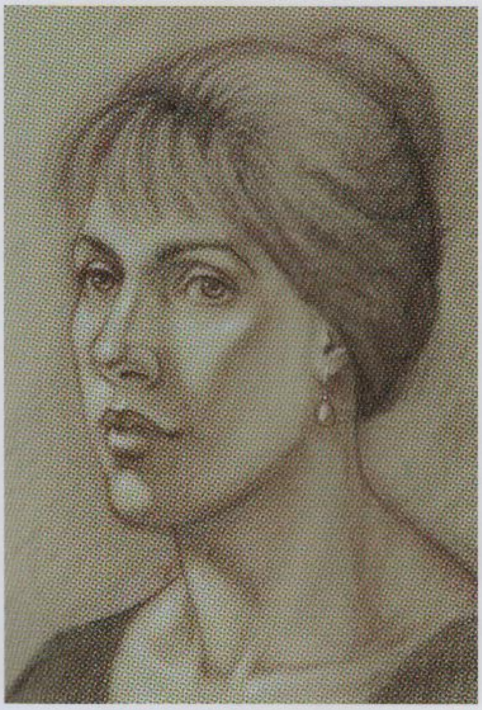
The cricoid cartilage is positioned below the thyroid cartilage. It encircles the trachea (windpipe), and its shape resembles that of a signet ring seen in reverse. The front part (the *arch of the cricoid cartilage*) can sometimes be detected on the surface form as a very small bump located below the more obvious form of the Adam's apple.

TRACHEA

The trachea, commonly know as the windpipe, is a flexible tube that is supported by C-shaped cartilage rings called *tracheal rings*.

THYROID GLAND

The thyroid gland has left and right lobes positioned on either side of the upper part of the trachea, creating a soft quality to the surface forms in the lower neck region.



WOMAN WITH A PEARL EARRING

The Features of the Face

The facial features are prominent soft-tissue structures that give each human face its unique quality. The features that are most important for artists to study are the eyes, nose, mouth, and ears, but the features include the hair mass on the cranium as well as facial hair such as eyebrows, eyelashes, mustaches, and beards.

Understanding the forms of the various features takes time and practice. Drawing the face in many different views is a great way to enhance your skill in depicting the challenging shapes of the lips, eyes, nose, and ears. These studies will help you see how the features appear to change shape as the head moves into different positions, especially foreshortened views. You will also gain a more acute awareness of how individual features and sets of features convey different expressions as their shapes are altered by the contraction of facial muscles.

The Eyes

While the mouth and lips are instrumental in conveying many expressions, the eyes are the most expressive of the features. The old proverb "The eyes are the windows to the soul" is very true: Looking into the depths of a person's eyes can reveal many subtle emotions—an inner sadness, a brooding anger, a glint of mischievous joy.

The eyes can be challenging to depict, so you should study their basic structure first and then look for the particular characteristics that convey the uniqueness of an individual person's eyes.

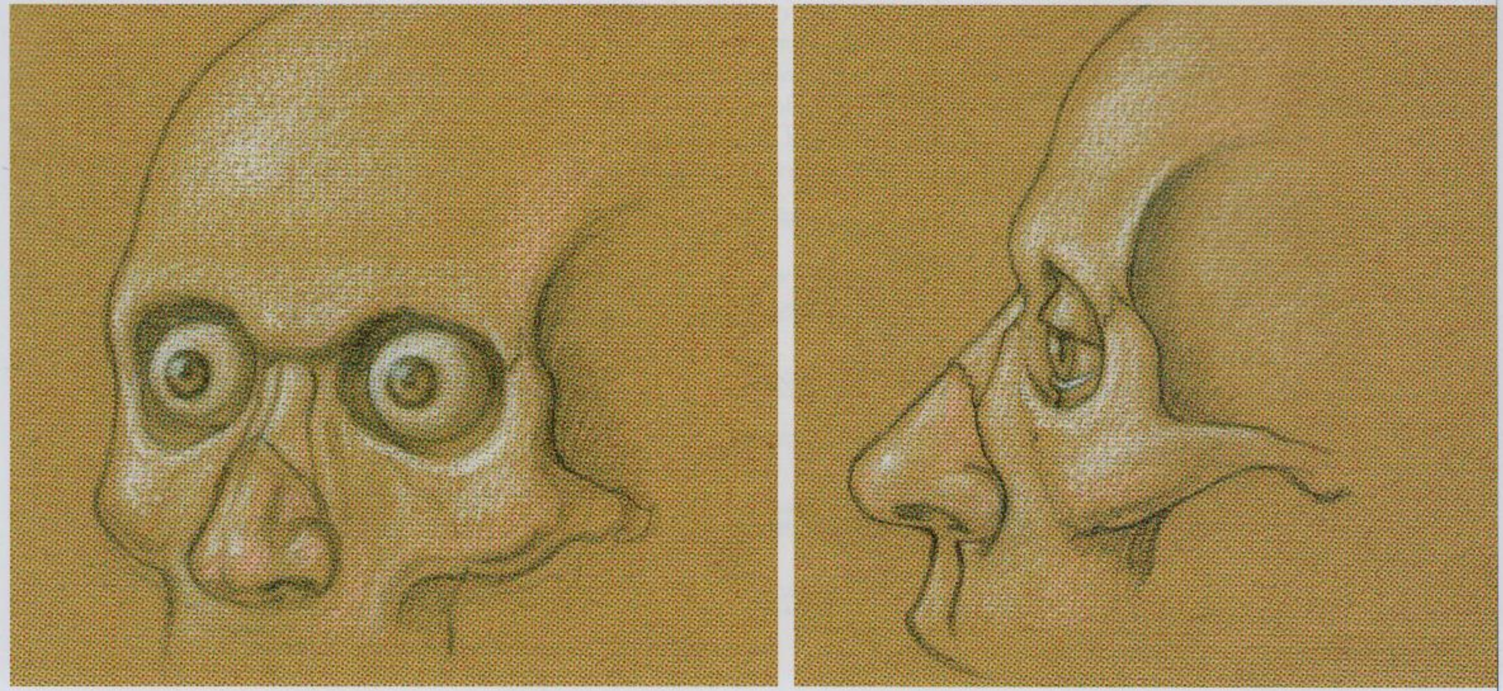
ORBITS

Several bones of the skull contribute to the structure of the orbits (eye sockets)—the two bony cavities that house and protect the eyeballs. The eyeballs (the globes of the eyes) are about one inch in diameter; each is held in place within the orbit by the several *extraocular muscles,* which help the eyes perform horizontal, vertical, and rotational movements. Within the orbits there are also small amounts of fatty tissue (*orbital fat*) that cushions the eyes.

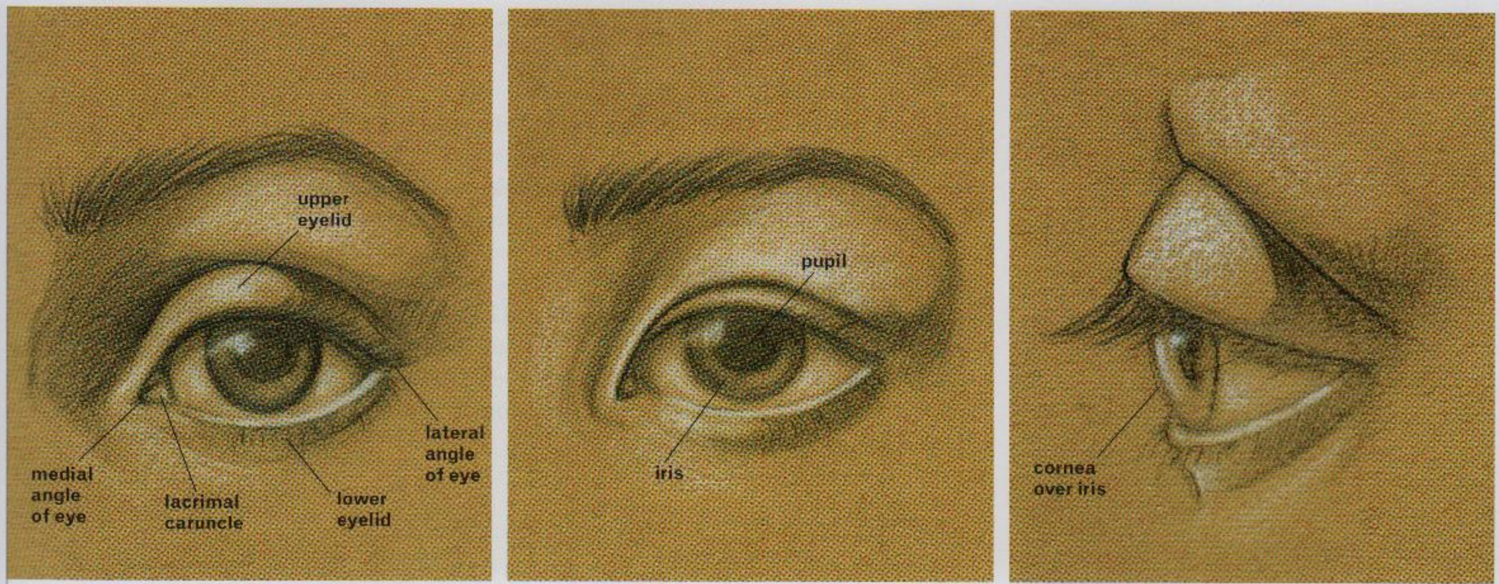
COMPONENTS OF THE EYEBALL

The "white of the eye" is an opaque layer of dense connective tissue called the *sclera.* The sclera's color is not actually pure white but ranges from yellowish white to grayish or bluish white.

The *iris* is the colored disc of the eye. The color of the iris varies greatly among people, ranging from deep brown, to medium brown, to olive green, to hazel (mixing green and brown pigments), to many shades of blue and gray. The disc of the iris appears to change shape—from a circle to a wide oval to a narrow ellipse—as the eye looks in different directions and as the



POSITION OF EYEBALLS WITHIN ORBITS OF CRANIUM



BASIC STRUCTURE OF EYE
Left: Anterior view—left eye with deep lid. Center: Anterior view—left eye with epicanthic fold. Right: Lateral view—left eye.

head rotates from a front view to a three-quarters view to a profile view.

In the center of the iris is a small aperture called the *pupil,* which fluctuates in size, dilating and constricting in response to the amount of light shining on the eye. In bright light, the pupil constricts to a small, piercing black dot. In dimmer light, it dilates to a much larger black disc.

The *cornea,* a convex, transparent tissue, covers the iris, transmitting and refracting (bending) incoming light. Artists need to note that the cornea gives a slight additional thickness to the iris shape.

Covering the entire anterior surface of the eyeball as well as the inner surface of the lids is a delicate membrane called the *conjunctiva.* In the inside corner of the eye, called the *medial angle of the eye* (or *inner canthus*), there is a glistening, fleshy, triangular shape called the *lacrimal caruncle.* The outside corner of the eye, where the upper and lower lids meet, is called the *lateral angle of the eye* (or *external canthus*).

The ball of the eye is kept moist by the tear ducts' secretion of tears, which wash away dust particles and give the eyes a glistening look. Any direct light source, natural or artificial, will reflect off the irises and corneas, creating a noticeable highlight in the eyes.

EYELIDS

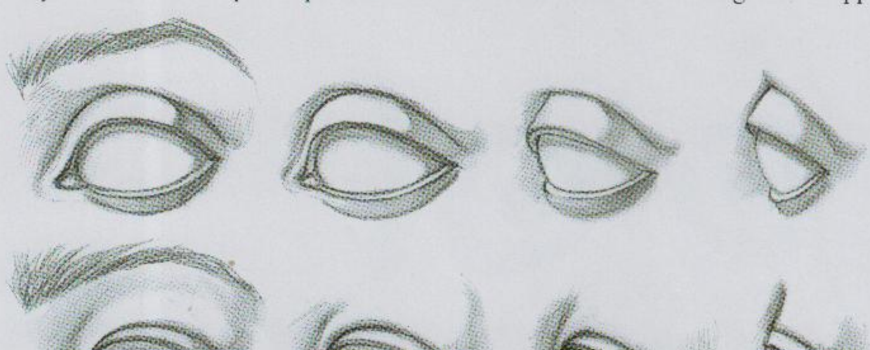
The upper and lower eyelids are portions of the orbicularis occuli muscle that are covered with extremely thin skin. In most views, the spherical shape of the eyeball is noticeable under the shape of the lids. The upper lid wraps over the ball of the eye much like a window awning. The raised form of the cornea subtly affects the form of the upper lid. If the eyes are looking in a particular direction, the upper lid rises slightly higher over the cornea/iris area, giving the contour of the upper lid a more distinct curve. The upper lid is longer and able to move more freely than the lower lid. The lashes on the upper lid curve in an upward direction and are usually longer than those of the lower lid.

The lower lid wraps around the eyeball like a low, curved wall. Light usually follows along the lower lid's rim, revealing its thickness. The lashes are shorter along the lower lid and curve slightly downward. In a relaxed face, the upper eyelid covers the topmost portion of the disc of the iris and cornea. The lower lid, by contrast, does not usually cover the iris but rides right next to its lower edge. In some expressions (such as the widening of the eyes), however, the upper lids move upward, exposing the full circle of the iris. And if the eyes look downward or squint, the lower lid will cover the lower portion of the iris.

VARIATIONS IN EYELID SHAPE

Human beings show a wide variation in eyelid shapes. In some people, the upper lid has a noticeable crease above (and paralleling) the curve of the eyeball. When this crease is very strong in appearance, it gives the effect of deep-set eyes.

Some people have a fold of skin on the upper eyelid that partially covers the inner corner of the eye. Sometimes referred to as the *epicanthic fold,* this crease rides close to the edge of the upper



ROTATION OF LEFT EYE (WITHOUT IRIS OR EYELASHES)
Top: Eye with deep lid rotating from anterior view to profile.
Bottom: Eye with epicanthic fold rotating from anterior view to profile.

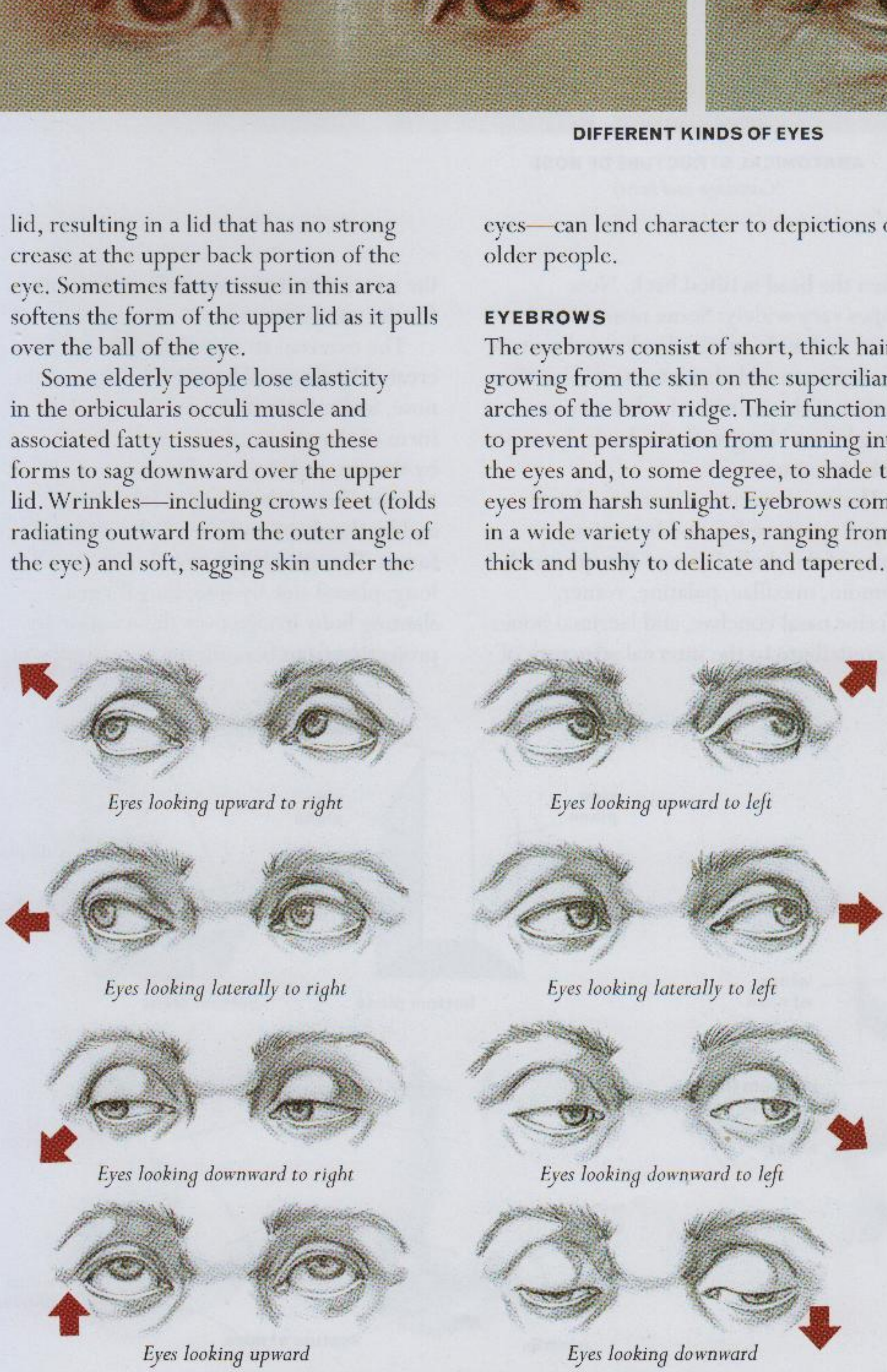
DIFFERENT KINDS OF EYES

lid, resulting in a lid that has no strong crease at the upper back portion of the eye. Sometimes fatty tissue in this area softens the form of the upper lid as it pulls over the ball of the eye.

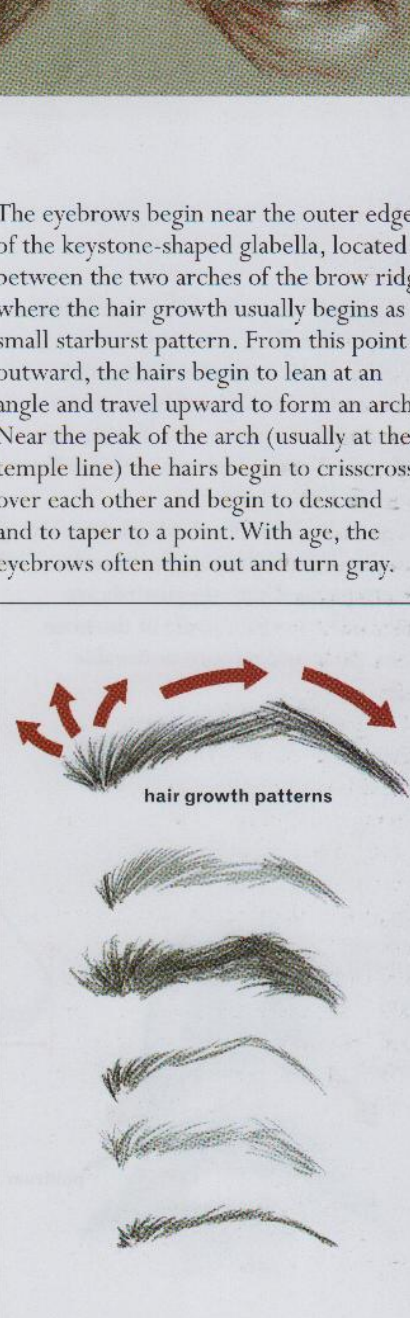
Some elderly people lose elasticity in the orbicularis occuli muscle and associated fatty tissues, causing these forms to sag downward over the upper lid. Wrinkles—including crows feet (folds radiating outward from the outer angle of the eye) and soft, sagging skin under the eyes—can lend character to depictions of older people.

EYEBROWS

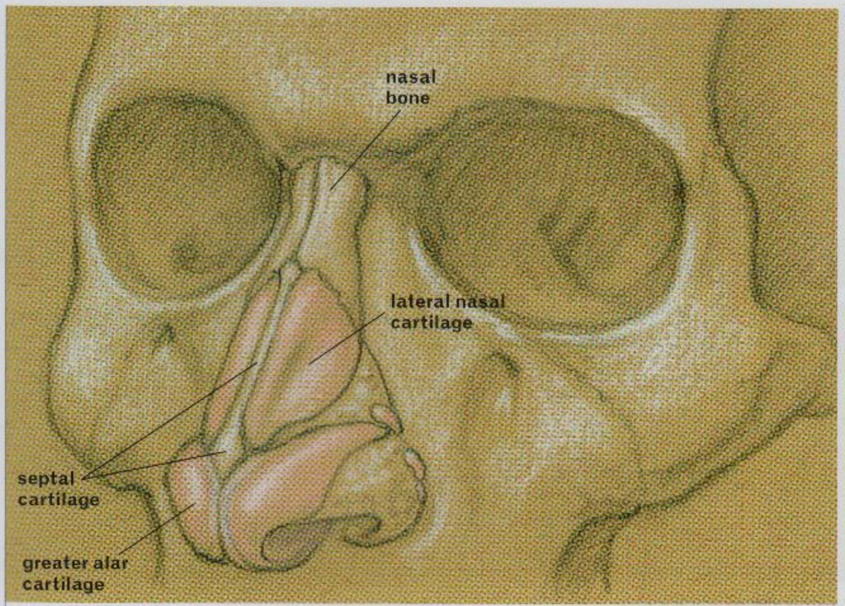
The eyebrows consist of short, thick hairs growing from the skin on the superciliary arches of the brow ridge. Their function is to prevent perspiration from running into the eyes and, to some degree, to shade the eyes from harsh sunlight. Eyebrows come in a wide variety of shapes, ranging from thick and bushy to delicate and tapered. The eyebrows begin near the outer edges of the keystone-shaped glabella, located between the two arches of the brow ridge, where the hair growth usually begins as a small starburst pattern. From this point outward, the hairs begin to lean at an angle and travel upward to form an arch. Near the peak of the arch (usually at the temple line) the hairs begin to crisscross over each other and begin to descend and to taper to a point. With age, the eyebrows often thin out and turn gray.

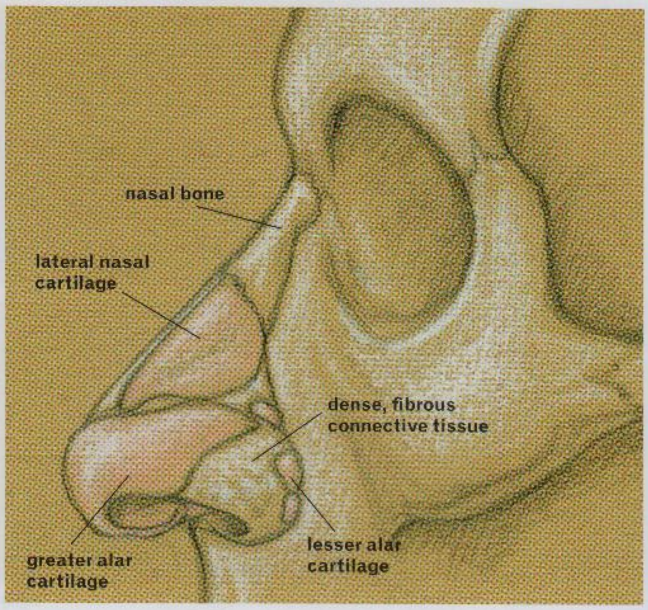


MOVEMENT OF EYES AND CHANGES TO SHAPE OF EYELIDS



EYEBROW CHARACTERISTICS
(Examples of left eyebrows)





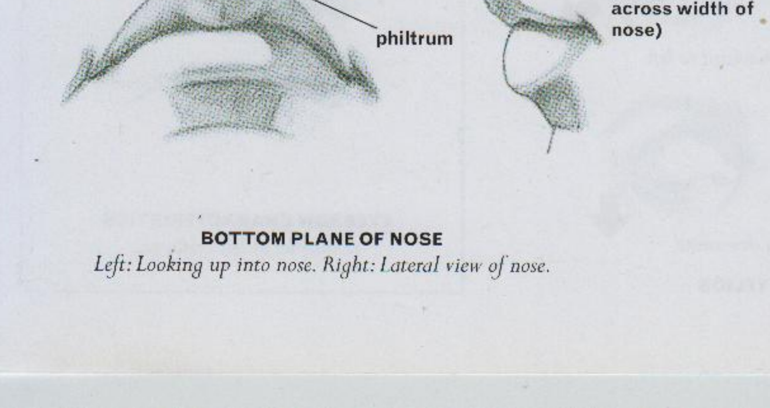
ANATOMICAL STRUCTURE OF NOSE
(Cartilage and bone)

The Nose

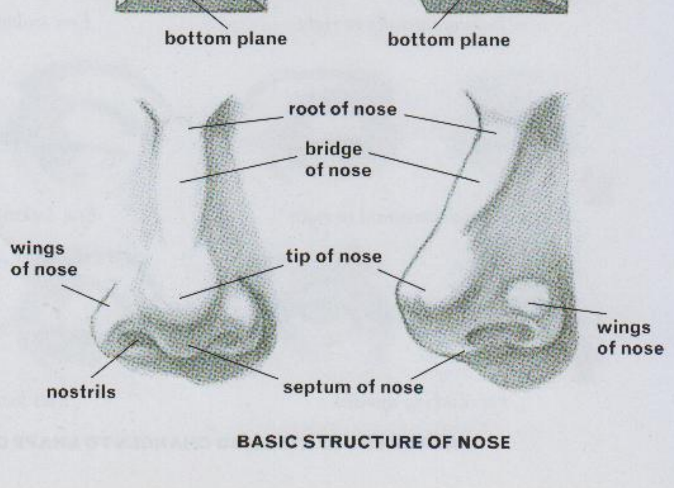
The general function of the nose is for olfaction (smelling) and respiration (breathing). Its anatomical structure consists of bone and cartilage, and its general shape is pyramidal. The surface of the nose has four planes: a top or front plane, which includes the bridge of the nose; two side planes, on either side of the top plane; and a bottom plane where the nostrils are located. The bottom plane of the nose is triangular and is more noticeable when the head is tilted back. Nose shapes vary widely: Some noses are broad and wide, some slender and narrow. The nose can add character to a depiction the face if the individual subtleties are brought out along with the basic dynamics of the structure.

The *nasal cavity* is an inverted heart-shaped aperture formed by various bones of the skull. Parts of the sphenoid, ethmoid, maxillae, palatine, vomer, inferior nasal conchae, and lacrimal bones all contribute to the internal structure of the nose, which provides a bony housing for the nasal sinuses.

The external structure of the nose is created by the nasal bones, cartilages of the nose, and soft-tissue forms. The general form of the nose is greatly influenced by the size and degree of projection of the *nasal bones* (the bridge of the nose) and by the shape and size of the cartilage forms. The nasal bones are about an inch long; placed side by side, they form a slanting bony bridge over the nasal cavity, projecting from beneath the bony wedge of



BOTTOM PLANE OF NOSE
Left: Looking up into nose. Right: Lateral view of nose.



BASIC STRUCTURE OF NOSE

the glabella between the brow-ridge arches of the orbits. This point of projection, from which the nose begins to slant away from the facial structure of the head, is technically referred to as the *nasion* but is more commonly known as the *root of the nose*. In some noses, the root of the nose can be seen as an obvious indentation, while other noses show a more subtle transition between the glabella, the root of nose, and the nasal bridge.

At the transition from the nasal bone to the cartilage, a small bump may occur on the surface form. This bump may be subtle or prominent, although some noses have a smooth transition between the nasal bones and cartilage.

The *nasal septum,* which consists of a bony part and a cartilage part, divides the interior of the nose into right and left cavities. A single cartilage along the midline of the nose (called the *septal cartilage*) forms the anterior part of the nasal septum. This cartilage creates a partition between the nostril openings (*nares*) that is sometimes referred to as the *septum*. The overall external shape of the nose is formed by other cartilages, which include the *lateral cartilages,* on each outer side of the nose; the *major alar cartilages* (or *greater alar cartilages*), which form the tip of the nose; three or four *minor alar cartilages* (or *lesser alar cartilages*), which are located near the wing of the nose and are small and hard to see; and a dense, fibrous connective tissue that forms each *wing of the nose* (or *ala*).

The *tip of the nose* (or *apex of the nose*) can vary significantly among individuals, depending on the shape of the cartilage beneath. Sometimes the tip (or ball) of the nose is more rounded, sometimes more angular. Some noses tilt upward, while others (especially those of elderly people) droop downward.

The wings of the nose create bulbous teardrop shapes on both sides of the tip of the nose. The wings can vary in size and shape. The nostril apertures are generally oval in shape, but they, too, can vary greatly depending on the shapes of the wings of the nose and the tip of the nose. Some nostrils have a shape like that of watermelon seeds, while others are more elongated or broad. To depict the nostrils accurately, however, you need to observe not just their shape but also the shadows within the nostrils.

The cartilages and connective tissues of the nose are covered by skin that is thicker than the skin elsewhere the face. Sometimes the highlights will appear very rich on the bridge and tip of the nose. Because the form of the nose projects from the face, it will cast a shadow onto the portion of the face opposite the light source. To make the nose appear more three-dimensional, it is essential to indicate the bottom plane of the nose with shadow.

The Lips and Mouth Region

The upper and lower lips are both part of the orbicularis oris muscle. The lips are challenging to draw, paint, and sculpt because they do not lie straight across the front plane of the face but curve gently back toward the sides of the head as they follow the horseshoe-shaped contours of the teeth.

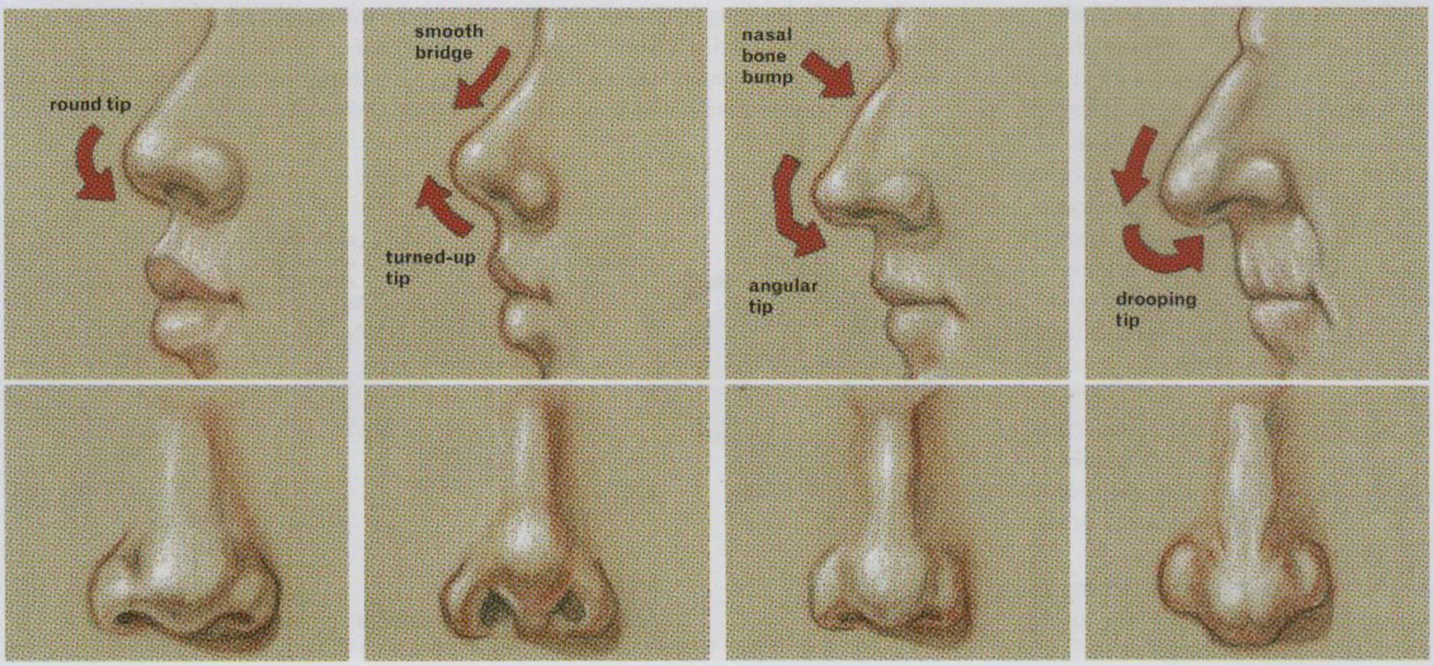
The skin on the lips is slightly thinner than the skin on the rest of the face, and the color is generally darker because of blood vessels that lie very close to the surface of the lips. The lips are sometimes referred as the *transitional zones, vermilion portions,* or *red lip portions,* though the color terms are somewhat misleading, in that the lips can vary in color from light pink, to pinkish red, to a deep reddish brown.

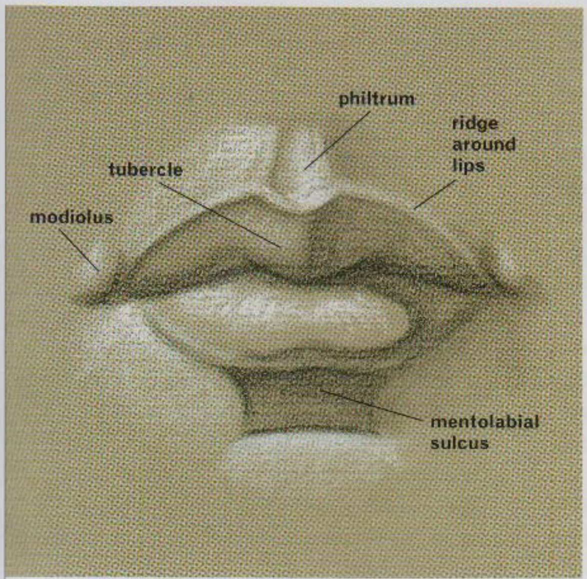
The central portion of the upper lip, called the *tubercle,* contains fatty tissue that creates a soft projecting form. The sides of the upper lip slope gently away from the tubercle. The lower lip, which is usually fuller in character than the upper lip, catches the highlights, whereas the upper lip is usually bathed in shadowed tones and reflected lights as it turns away from the light source.

At each corner of the mouth is a small fleshy mound called the *modiolus.* This is actually the intersection of the connective tissues by which several muscles attach in this region. On the surface form, the

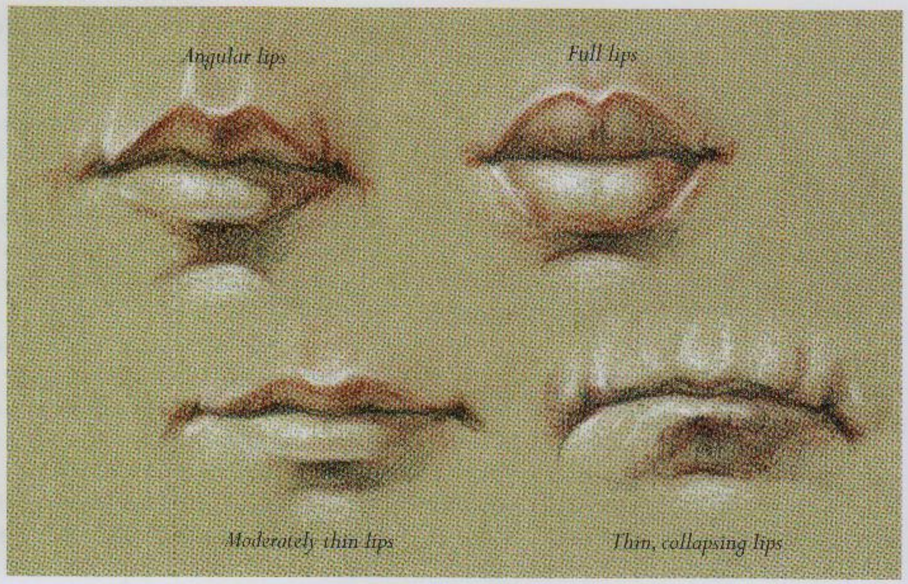
DIFFERENT NOSE SHAPES

Wide, broad nose (round forms) | *Narrow nose with turned-up tip* | *Angular forms* | *Drooping and enlarged tip*





LANDMARKS OF LIPS AND SURROUNDING REGION



DIFFERENT LIP SHAPES

modiolus creates a little tuck of skin at each end of the lips, sometimes catching a small shadow near the tuck, with light on the top of the fleshy mound portion.

A thin ridge encompasses both lips on their outer margins. This ridge, which is created by fibrous connective tissue between the orbicularis oris proper and the forms of the lips, usually catches highlights and is more noticeable on darker skins.

Lips come in a great variety shapes and sizes. Some people's are very thin, while others' are full and sensual. Lips can change shape dramatically as facial expressions change or as a person speaks or vocalizes. When the jaw drops downward, the lips stretch vertically. When smiling, the lips will stretch horizontally with an upward curve at the ends. In a grimace, the lips will stretch horizontally and curve downward.

The groove that sits above the center of the upper lip is called the *philtrum*. Philtrums, too, vary in shape: Some are obvious and deep, while others are very subtle. Philtrums can also be long or short, depending on the distance between the nasal septum and the margin of the upper lip.

Beneath the lower lip, a plane change occurs that usually catches shadows. This small indentation above the chin mass is anatomically referred to as the *mentolabial sulcus*.

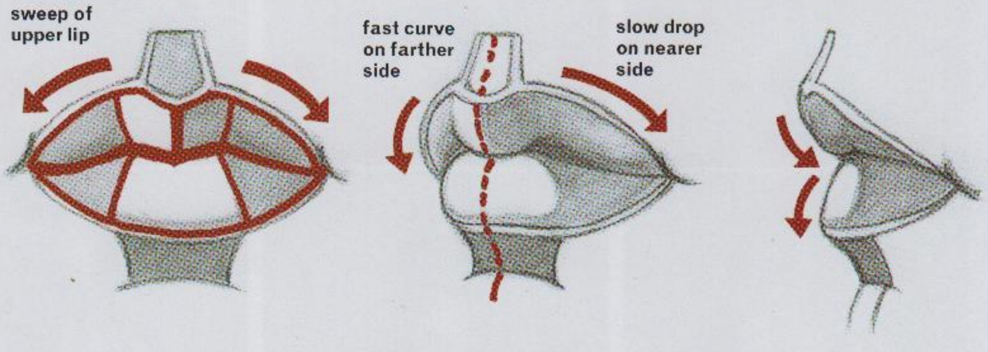
The *nasolabial furrow* is a curving fold of skin that begins near the wing of the nose and extends to the outer corner of the mouth. In younger people, the furrow it is hardly noticeable when the lips are neutral but becomes more apparent when a person is smiling, laughing, or making an expression of disgust. When the corners of the mouth are depressed downward, the nasolabial furrow becomes more straight and angular. With age, the nasolabial furrow (along with other facial folds) becomes permanently etched on people's faces and is visible even when the face is in a relaxed, nonexpressive state.

The Ears

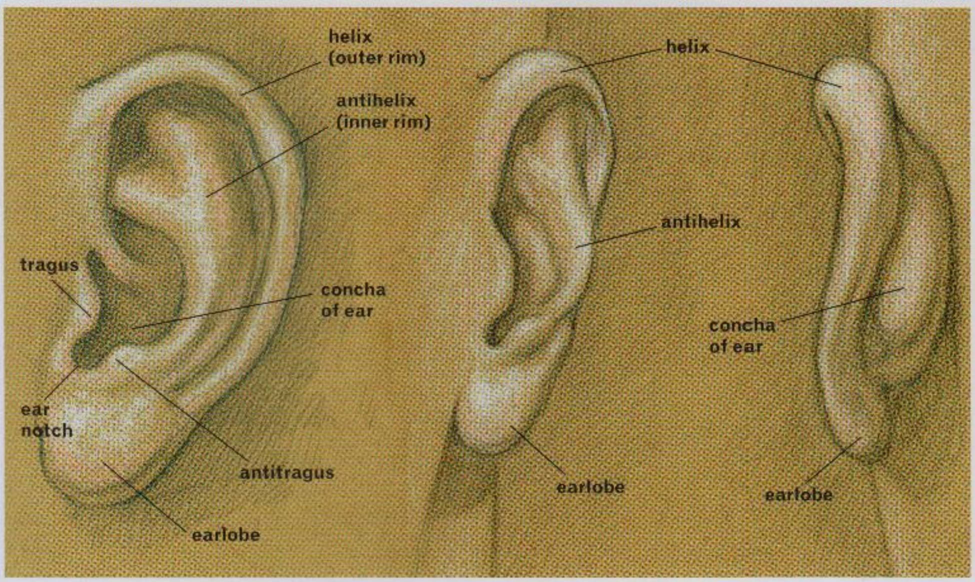
The external ear (referred to anatomically as the *auricle*) has long fascinated artists because of its unusual, shell-like organic forms. The ear is constructed of a bowl-like cartilaginous container with spiraling tubular shapes and small, bump-like projections. The variation is enormous: Ears can be small and delicate or large and bulky. They can lie snugly against the sides of the head or project outward.

With the exception of the earlobe, which consists mainly of fatty and fibrous tissue, the entire ear is composed of elastic cartilage and is completely covered with very smooth skin. There are no bones in the external ear, but the inner ear (invisible on the surface form) includes among its structures three *ossicle bones,* which are the smallest bones in the body. The outer ear's convoluted form is positioned over the *ear canal* (or *external auditory meatus*) and acts as a collector of sound waves, which it funnels into the inner ear.

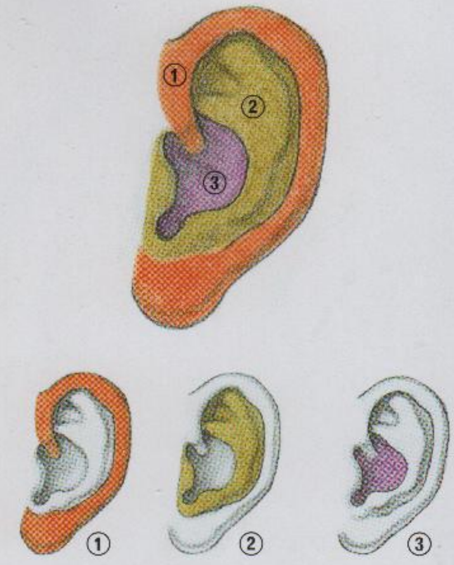
The intriguing shape of the ear may at first seem challenging, but breaking



PLANES AND CURVES OF LIPS
Left: Anterior view. Center: Three-quarters view showing center division. Right: Profile lips.



FORMS OF THE EAR
Left: Lateral view of left ear. Center: Slightly three-quartered anterior view of left ear. Right: Posterior view of left ear.



THE THREE PORTIONS OF THE EAR
1: Helix (outer rim). 2: Antihelix (inner rim). 3: Concha.

it down into simpler components helps clarify the basic structure. The ear is essentially divided into three portions: the *concha, helix,* and *antihelix.*

The *concha* projects from the side of the head like an acoustical speaker. Its basic structure is that of a bowl, but on lateral (side) views of the head, the concha appears as a small area bathed in dark tones and surrounded by the rims and lobe of the ear. The ear hole (external auditory meatus) is completely hidden by the targus in all views of the ear.

The tubular *helix* (the outer rim of the ear) has a shape similar to the letter C. This rim terminates into the earlobe (or *lobule*). Occasionally the outer rim is round and smooth; sometimes it has sharp edges and perhaps even some subtle bumps along the perimeter of the ear. Earlobes can range from long, hanging flaps to fleshy little mounds to very small, very minimal lobes.

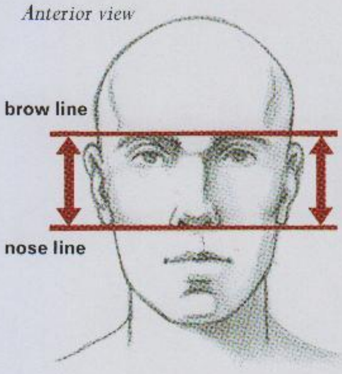
The *antihelix* (inner rim of the ear) is a raised, curved form that nestles inside (and close to) the helix. Its shape resembles a curved or bent letter *Y.* The antihelix terminates into the lobe area, but on the inside edge, next to the concha, it widens into a small bump called the *antitragus.* Across from the antitragus is another, slightly larger bump called the *tragus.* The tragus is a cartilaginous flap that acts as a protective shield over the hole leading into the inner ear. Between the tragus and antitragus is the *ear notch.*

When viewed from the front or side, with no foreshortening of the head, the ears lie approximately between the brow line and the nose line. On a standard profile of the face, there is a great deal of space between the ear and the outer corner of the eye. Generally, this space is equivalent to the space between the bottom of the chin (chin line) and the nose line. The ear is positioned at an angle, mimicking the short angle of the jawbone. As the head rotates, the perceived space between the outside of the eye and the ear alters. To correctly gauge this interval, measure the space with a pencil (or other drawing tool) and compare it to an interval between other facial features.

In foreshortened views of the head, the ears appear to change position because of the perspective from which the head is being viewed. As the head is lowered, the ears appear to rise higher on the skull, sometimes even looking as if they are positioned above the brow line. As the head is tilted upward, the ears appear to drop downward below the brow line.

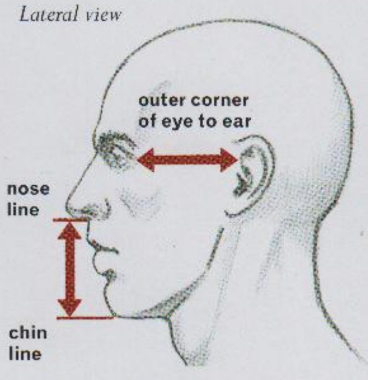
PLACEMENT OF EAR FORMS ON HEAD

Anterior view



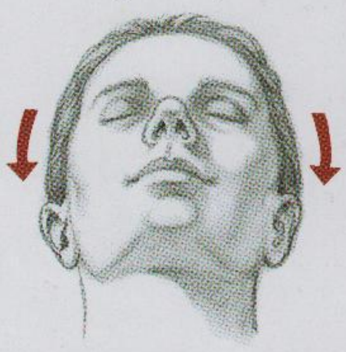
Ear placement is approximately between the brow line and the nose line.

Lateral view

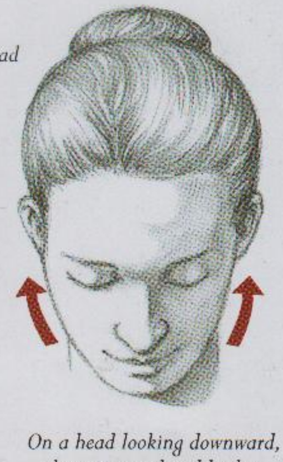


The distance between the ear and the outer eye is approximately the same as that between the chin and the nose line.

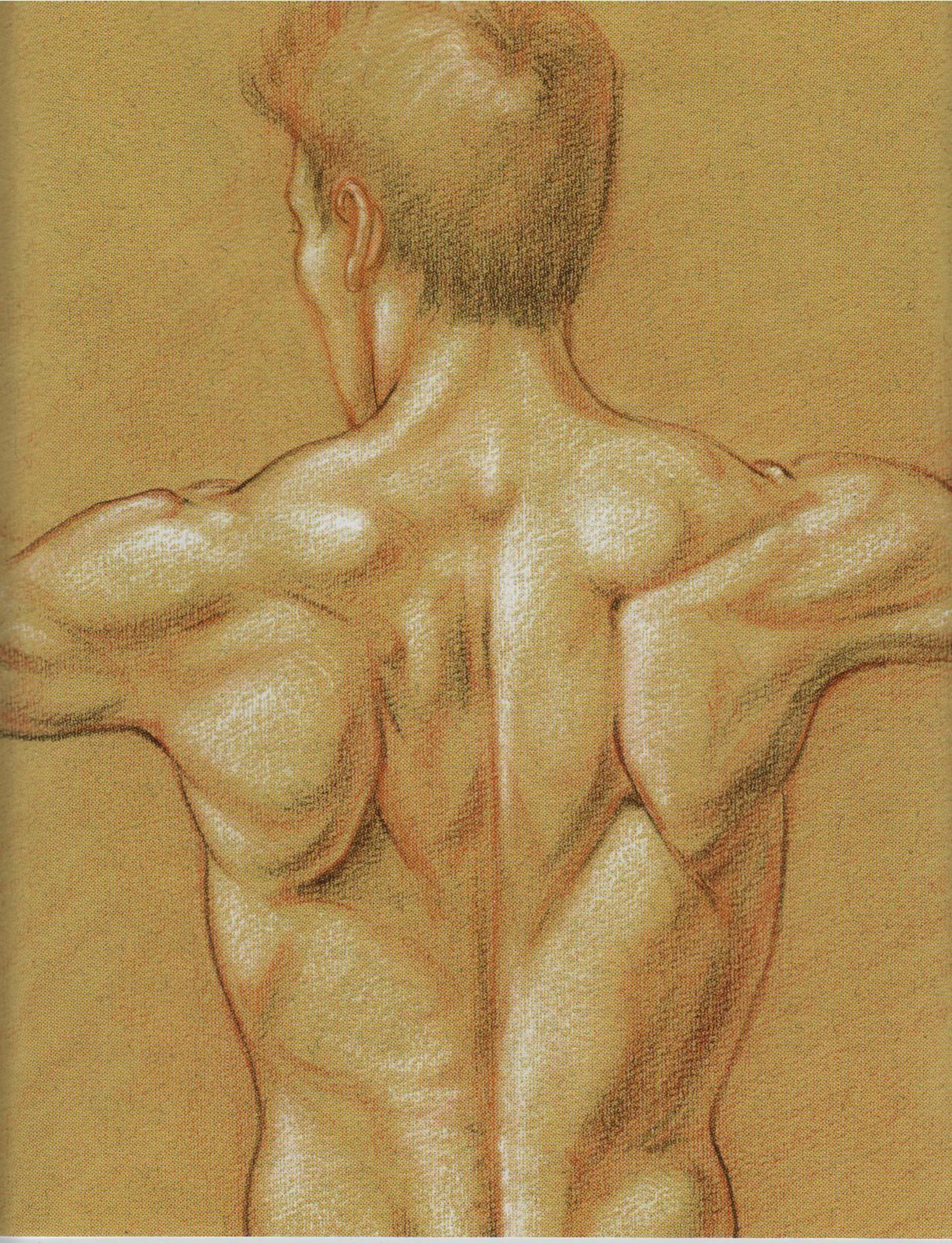
Placement of ears on a foreshortened head



On a head looking upward, the ears are placed lower than the brow line.



On a head looking downward, the ears are placed higher than the brow line.



Chapter 3 The Torso

The term *torso* refers to the trunk of the body—the region extending from the base of the cranium down to where the legs attach to the pelvis, excluding the arms. When artists depict the torso, however, their studies generally include part of the upper legs, as well as the head and arms.

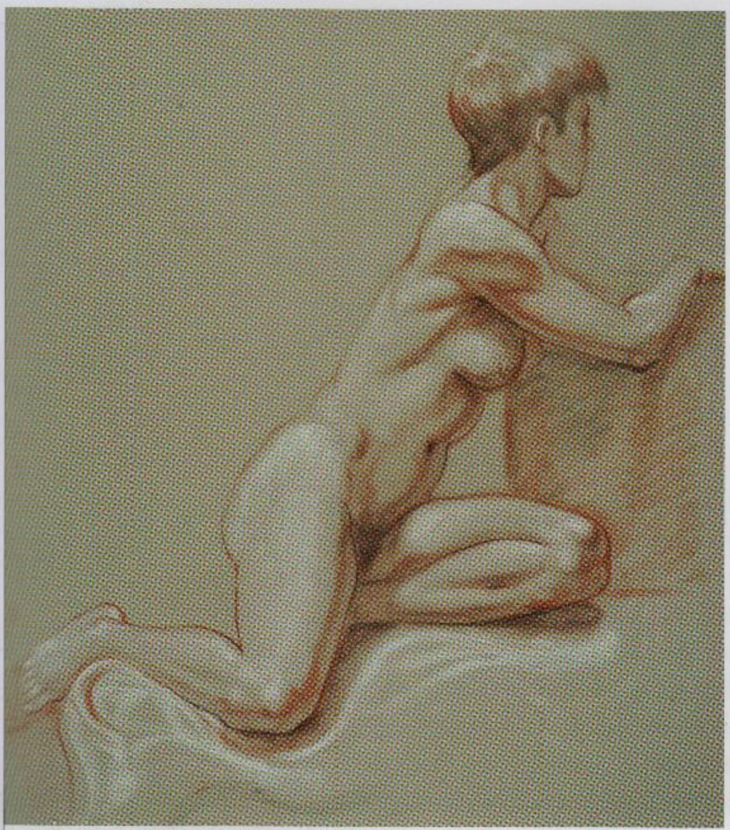
Figurative artists have always found the torso to be an important and expressive part of the human body. The female torso, as depicted in art, has gone through numerous transformations over thousands of years. The small, voluptuous torso figurines of Paleolithic times, such as the Venus of Willendorf (c. 21,000 BCE) have soft-looking, round abdomens and pendulous breasts, which may have represented fertility and mystical powers. Thousands of years later, ancient Greek and Roman artists portrayed the female torso form with idealized proportions and lyrical qualities. The Cnidian Aphrodite, by the Greek sculptor Praxiteles (active c. 370–330 BCE) is one example of this classical type of feminine torso.

During the Renaissance and the Baroque era, a plump torso on a woman signified wealth and attractiveness, because it showed that the woman could afford to eat in luxury—as opposed to a thin or skeletal torso, which represented poverty and sickness. The Flemish artist Peter Paul Rubens (1577–1640) often painted women with sensual, voluptuous forms, as in his *Toilet of Venus* (or *Venus at Her Mirror,* c. 1613). This attitude reversed in the twentieth century, when extremely thin fashion models became the norm for beauty and success, while heavy women were often ostracized.

Female figurative artists of the twentieth century often rebelled against what they saw as male artists' sexist interpretation of the female figure, exploring a more personal or psychological approach. The figure paintings of Tamara de Lempicka (1898–1980) were influenced by the Art Deco style and contain a combination of geometric shapes and organic sensuality, fluctuating between masculine and feminine qualities. *Nude with Sails* (or *L'Heure Bleue,* 1931) is one of de Lempicka's sensual yet stylized and geometric depictions of the female torso. Mexican artist Frida Kahlo (1907–1954) often painted self-portraits emphasizing her personal suffering, as in *The Broken Column* (1944), in which the artist's torso is shown bound by a medical brace and punctured with nails. Many people see these breakthrough interpretations of women's bodies as representations of individuality, strength, and vitality. For others, however, they are the antithesis of the traditional concept of feminine beauty.

Images of men's torsos have also changed over time, but the general emphasis has primarily been on muscular forms. In classical times, the

Opposite: **BACK STUDY ON TAN PAPER**



STUDY OF SEATED WOMAN, SIDE VIEW

well-muscled male torsos in images of mythological figures, athletes, monarchs, and military leaders symbolized strength and power. The marble sculpture Discobolus (Discus Thrower, c. 460–450 BCE), by the Greek sculptor Myron, is a very famous example of this kind of depiction of the torso.

During the middle ages, the male figure was depicted as a humble penitent; however, the muscular male image returned during the Renaissance. As ancient Greek and Roman sculptures were rediscovered, they captivated artists like Michelangelo (1475–1564), who was greatly influenced by the robust and muscular Belvedere Torso by the ancient Athenian sculptor Apollonius (first century BCE). Michelangelo's depictions of anatomically vibrant male figures in the Sistine Chapel's ceilings and altarpiece show his passion for the classical nude.

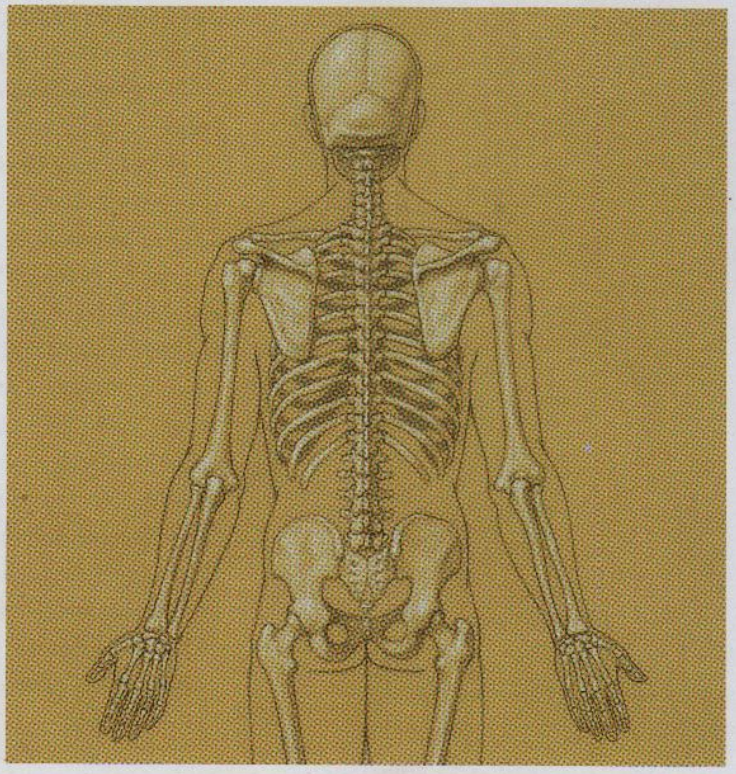
Following the Renaissance, artists began investigating variations of male body types, including those of the "common man" (as in the paintings of guildsmen and civic guards by Frans Hals, 1580–1666) and the sensual, feminine male (as in the paintings *Bacchus* [1595] and *Amor Vincit Omnia* ["Love Conquers All," 1601–1602] by the Italian Baroque artist Caravaggio [1571–1610]).

In the twentieth century, depiction of the male torso fluctuated between classical yet personal representations, as seen in works by American artist Paul Cadmus (1904–1999) and intensely psychological figures, as in the paintings of the German-born British artist Lucien Freud (b. 1922).

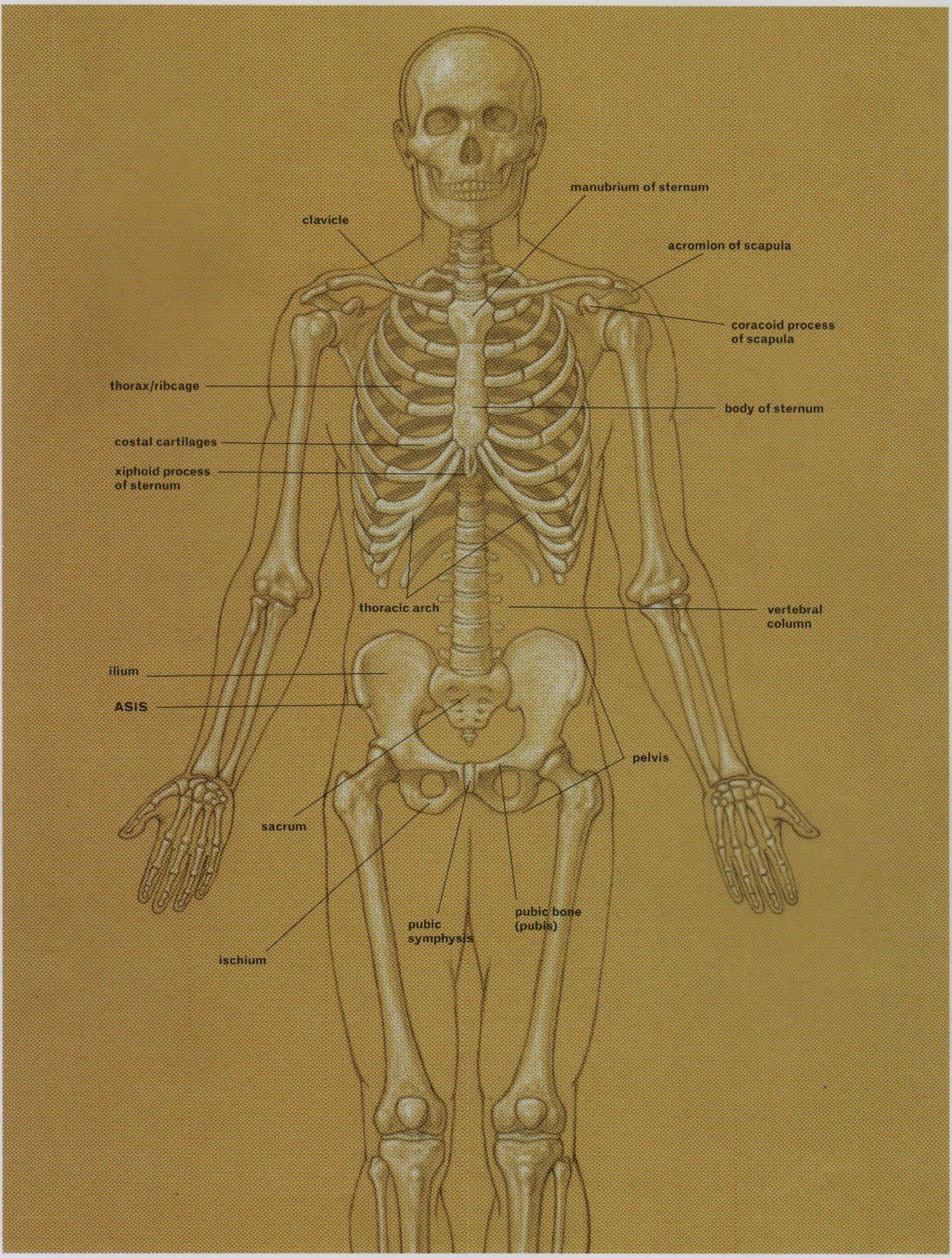
Understanding the muscular and skeletal forms of the torso region is essential for figurative artists. Studying human figures from works of art as well as from living models will enhance your ability to portray the human torso in all its uniqueness.

The Bones of the Torso

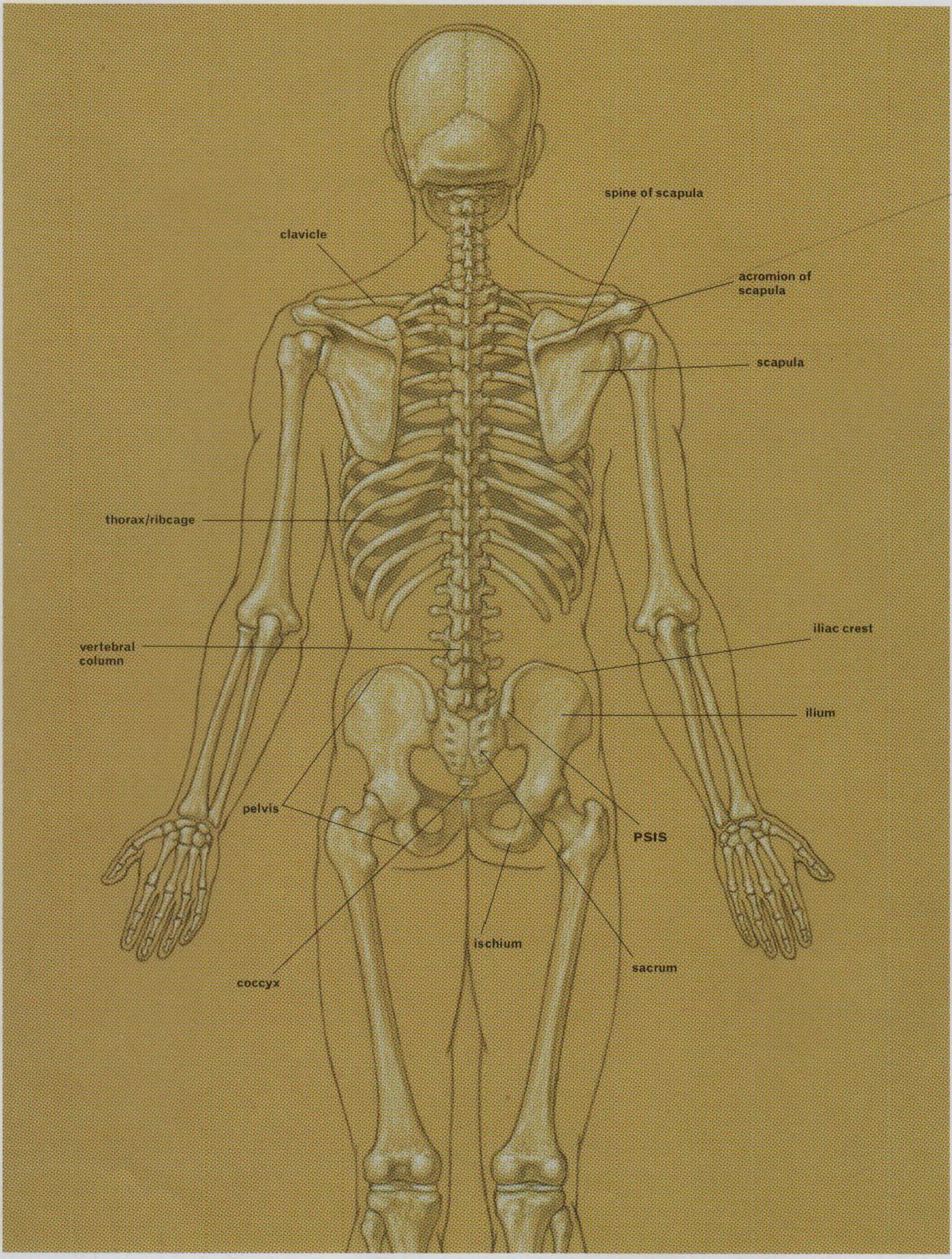
The main bony components of the torso region are the vertebral column, ribcage (or thorax), and pelvis. The bony shoulder girdle includes the scapula bones (shoulder blades) and the clavicles (collarbones), which move into slightly different locations depending on the action of the arms. Observing evidence of these bones on the surface of the body can help you in placing the muscles of the torso region.



BONES OF TORSO (POSTERIOR VIEW)



BONES OF TORSO (ANTERIOR VIEW)

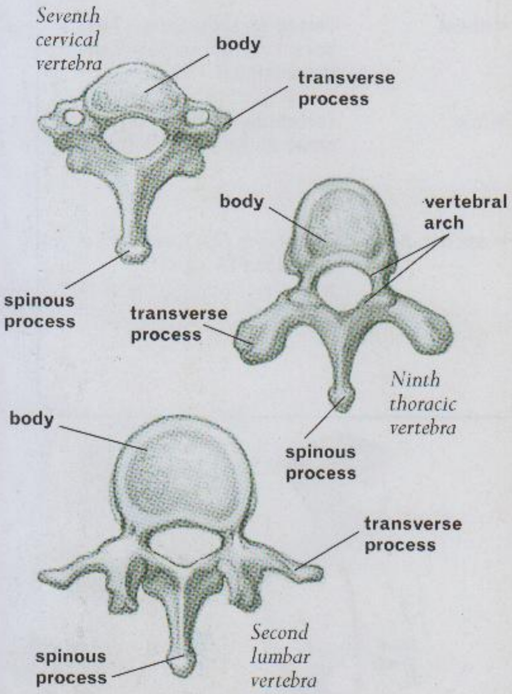


BONES OF TORSO (POSTERIOR VIEW)

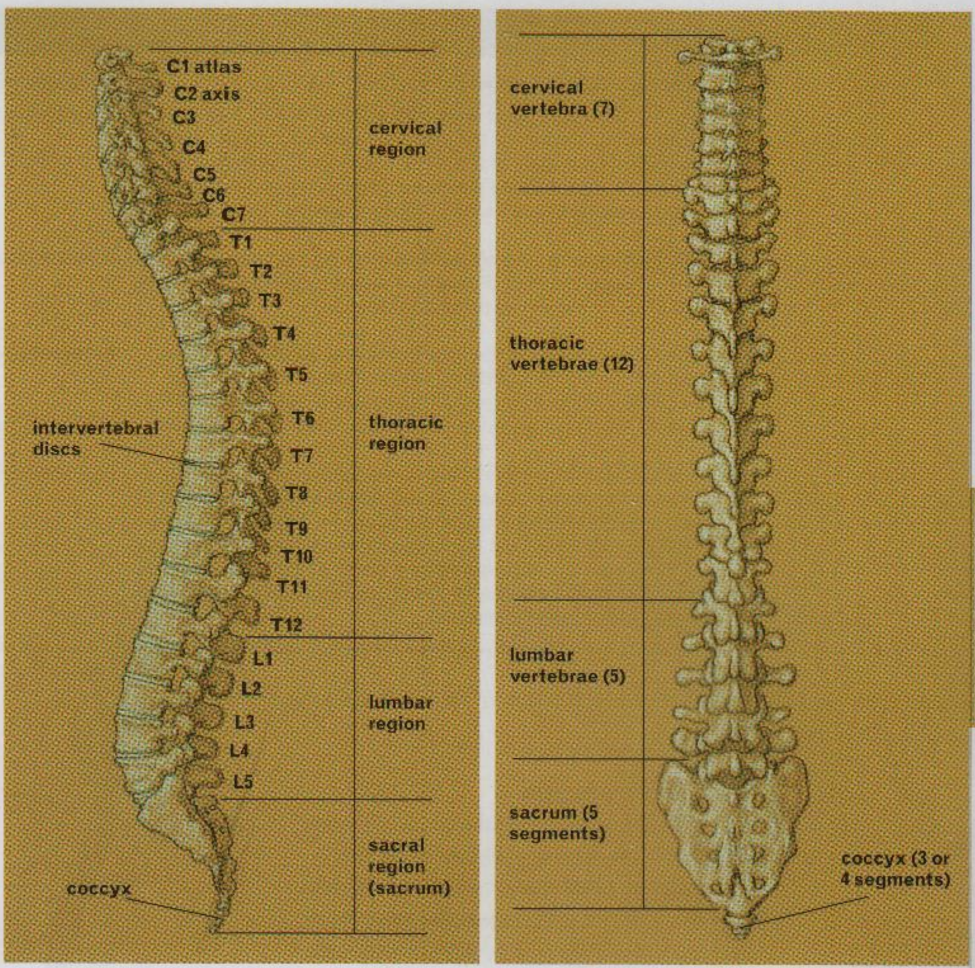
Vertebral Column

ORIGIN OF THE TERM
Latin *vertebra,* from *verto* = turn

SYNONYMS
columna vertebralis (TA), spinal column, spine, backbone, rachis, spina



VERTEBRAE—EXAMPLES



VERTEBRAL COLUMN: LATERAL VIEW, LEFT SIDE *(left)*; POSTERIOR VIEW *(right)*

Vertebral Column

The vertebral column, or spine, extends from the cranium to the sacrum bone at its base. It provides a strong support pillar for the cranium and torso but is also flexible and capable of various movements. Each of the twenty-four individual bones of the vertebral column is called a *vertebra* (pronounced VER-teh-brah); the plural is *vertebrae* (VER-teh-bree or VER-teh-bray).

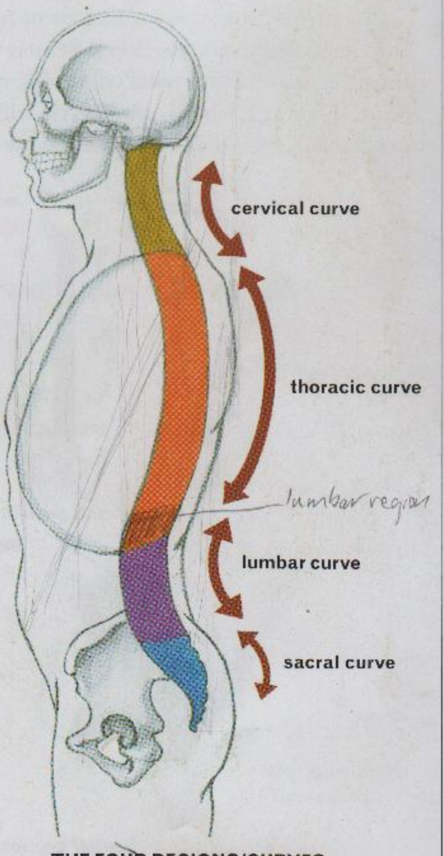
With the exception of the first cervical vertebra (the *atlas*), each vertebra has a cylindrical, drum-shaped form called the *body* (or *centrum*). An arch-like projection, called the *vertebral arch,* extends from the body of the vertebra, and three basic projections extend from this arch: the two *transverse processes,* which project outward on either side of the arch, and the *spinous process* (or *vertebral spine*), which projects from the back of the vertebral arch. The transverse and spinous processes all serve as attachment locations for ligaments and muscles that help move and stabilize the vertebral column.

When the figure bends forward (flexion of the spine), it is sometimes possible to see the spinous processes pressing against the skin, looking like small beads on the surface. Otherwise, in most other poses, only the spinous processes of the seventh cervical vertebra and first thoracic vertebra are noticeable on the surface form.

THE FOUR REGIONS/CURVES OF THE VERTEBRAL COLUMN

The vertebrae are not stacked directly atop one another like the stone drums of a Greek column, but rather are strategically placed to produce four distinct curves in the spine when the figure is in a normal standing pose. You can easily see these subtle curves when you view the figure from the side. (From the back, the vertebral column appears to be straight when the figure is standing erect.) The four curves correspond to four areas of the body and are called the *cervical, thoracic, lumbar,* and *sacral-coccygeal curvatures.*

The four distinct curves of the spinal column can become hard to locate when the body adopts different action poses, but it is still possible to locate the spinal regions of the neck, ribcage, and small



THE FOUR REGIONS/CURVES OF VERTEBRAL COLUMN

The Four Regions of the Vertebral Column

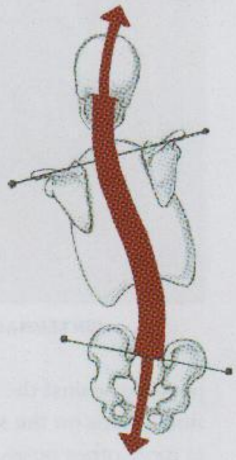
REGION	DESCRIPTION AND CHARACTERISTICS	ORIGIN OF TERM	SYNONYMS
Cervical vertebrae (SIR-vuh-kull *or* SIR-vick-ul)	The seven vertebrae of the neck region (C1–C7). The first vertebra (C1) is called the *atlas*; the second (C2) is called the *axis*. At the back of the neck, the seventh vertebra (C7, or *vertebra prominens*) surfaces close to the skin, creating a prominent landmark when viewed from the back.	Latin *cervix* = neck	vertebrae cervicales (TA), vertebrae of the neck
Thoracic vertebrae (thor-RASS-ick)	The twelve vertebrae of the thorax/ribcage region (T1–T12). The ribcage consists of twenty-four ribs; each pair of ribs is attached to one of the thoracic vertebrae.	Greek *thorax* = chest	vertebrae thoracicae (TA), dorsal vertebrae, vertebrae thoracales, TI–TXII
Lumbar vertebrae (LUM-bar)	The five vertebrae of the small of the back (L1–L5). These vertebrae of the transitional region between the ribcage and pelvis are the largest in the vertebral column, because they support the weight of the ribcage, neck, and cranium.	Latin *lumbus* = loin	vertebrae lumbales (TA), small of the back, LI–LV
Sacrum (SAY-crum)	A triangular bone consisting of five fused vertebrae. This base of the spinal column, positioned in the center of the pelvis, is a significant landmark because it helps verify the location of the hips. At the base of the sacrum is the coccyx (KOCK-six; from Greek *kokkux* = cuckoo [because of its resemblance to a cuckoo's beak]), or tailbone, consisting of three or four fused vertebrae.	Latin *sacrum* = sacred, holy	os sacrum (TA), vertebrae sacrales (TA), sacral triangle, triangle bone of the pelvis

of the back, as well as the triangular shape of the sacrum in the pelvic region.

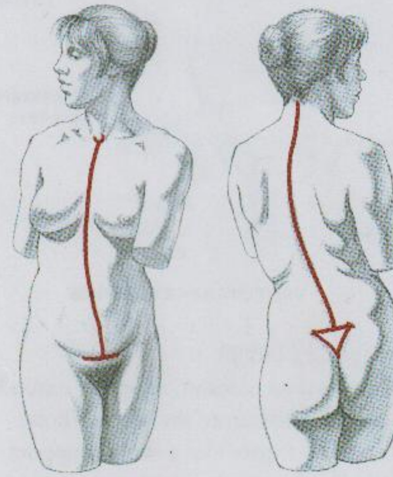
ACTION OF THE VERTEBRAL COLUMN

The vertebral column establishes the central axis of the figure. Its placement helps describe any bending, rotation, or other movement of the torso region. With the exception of the first and second vertebrae, the individual vertebrae are separated by pads of fibrocartilage, called *intervertebral discs,* which act like shock absorbers, allowing the spinal column to bend in various directions.

In more dynamic poses, various movements of the spine are combined (for example, lateral flexion with rotation). Observing the placement of the spinal column as well as the positions of the head, shoulders, ribcage, and pelvis will help you to analyze the general dynamics and energy of the torso in most poses.

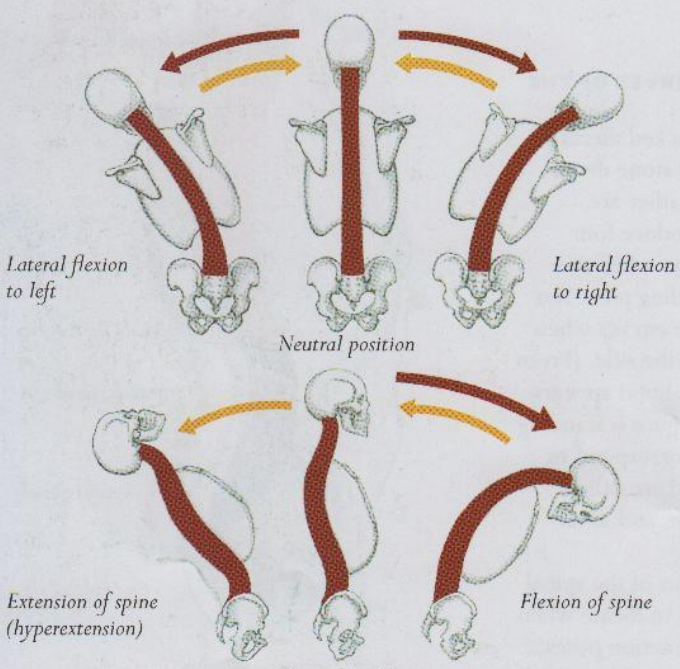


Contrapposto (S-curve to spine)



Rotation (pivoting of spine)

CONTRAPPOSTO AND ROTATIONAL MOVEMENT OF VERTEBRAL COLUMN



ACTION OF VERTEBRAL COLUMN

Movements of the Vertebral Column

REGION	DESCRIPTION AND CHARACTERISTICS
Flexion of vertebral column	Bending the spine forward.
Extension of vertebral column	Bending the spine backward; sometimes referred to as *hyperextension* if the bending is exaggerated.
Lateral flexion of vertebral column	Sideways bending in which the shoulder (right or left) moves toward the pelvis.
Rotation of vertebral column	A spiraling, twisting, or pivoting of the spine that occurs when the ribcage rotates to a slightly different position from the pelvis. The movement can be carried farther by pivoting the skull and neck as well, creating a more dynamic spiraling action throughout the torso.
Contrapposto	Classical pose in which a subtle, flowing S-curve occurs throughout the spine. If the weight rests on one leg, the hip will tilt, causing a counterbalance reaction in the shoulders, which tilt in opposition.

Thorax/Ribcage

PRONOUNCIATION
THOR-racks

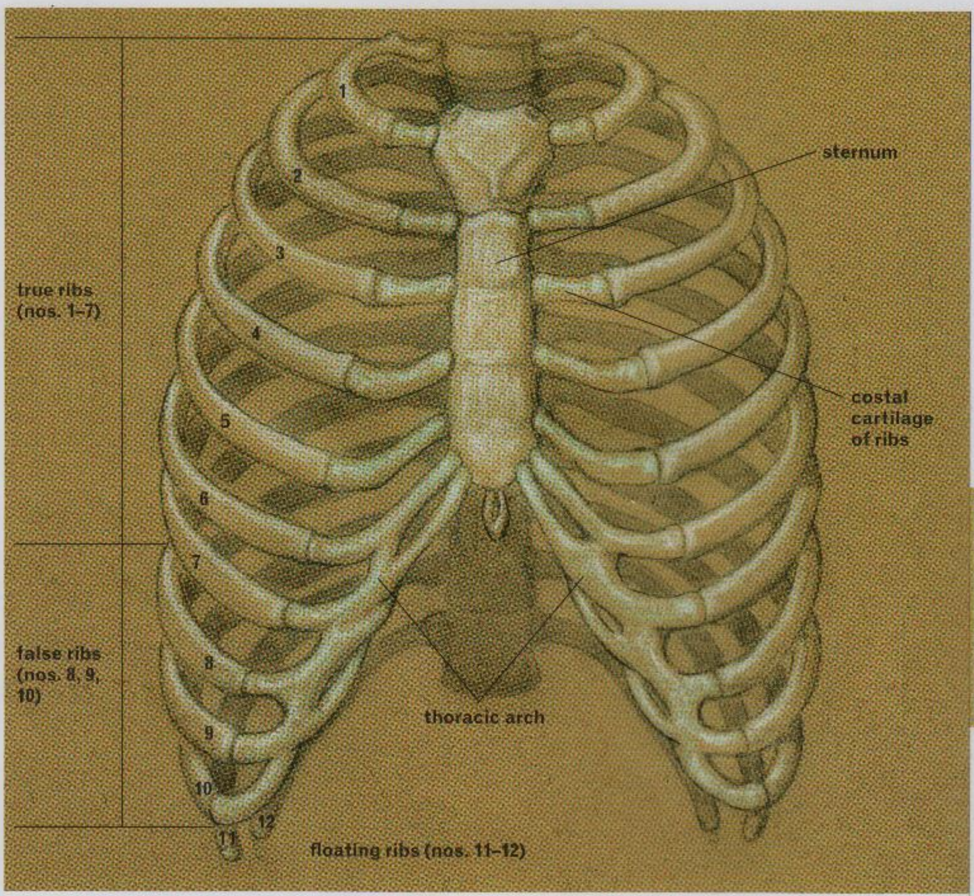
ORIGIN OF THE TERM
Greek *thorax* = chest

SYNONYMS
cavea thoracis (TA), thoracic cage, thoracic basket

Thorax/Ribcage

The thorax, or ribcage, consists of twelve pairs of ribs that together form a three-dimensional oval shape resembling a birdcage. The twenty-four individual ribs are attached to the twelve thoracic vertebrae of the spinal column. With the exception of the bottom two pairs of ribs, the ribs extend all the way to the front of the body, where they attach to the *sternum* (breastbone) by connective tissue called *costal cartilage*. This cartilage can sometimes be detected on the surface form, appearing as small, elongated bumps near the sternum. The *thoracic arch* (or ribcage arch) is composed entirely of cartilage; its shape can be seen when a person is stretching upward or dramatically contracting his or her abdominal muscles.

The first seven pairs of ribs are referred to as the *true ribs*, because they attach directly into the sternum with their own costal cartilage. The next three pairs (numbers 8, 9, and 10) are referred to as the *false ribs*, because their costal cartilage fuses into a single, branchlike form as it heads toward the sternum for attachment. Some experts also classify the last two pairs of ribs as false ribs, but they are much more commonly known as the *floating ribs*, because they have only a small amount of cartilage at their tips and do not attach to the sternum at all.

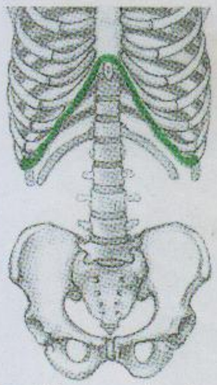


THORAX/RIBCAGE (ANTERIOR VIEW)

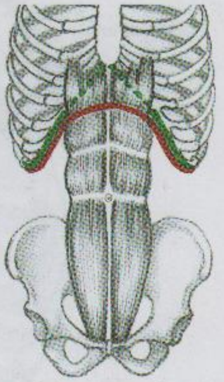
THORACIC ARCH—CHARACTERISTICS

There are actually two different arches in the ribcage and abdominal region, and their prominence varies among individuals. The *skeletal arch*, or *anatomical arch*, is given its shape by the costal cartilage of the thoracic (ribcage) arch and is more noticeable in thinner people. If the external oblique muscle is not very developed, then the sharp protrusions of the ribcage cartilage are more pronounced, giving the arch a more angular appearance on the surface form.

The other arch is called the *abdominal arch*, or *Greek arch*, and is more easily seen in muscular figures. It is caused by the muscular bulge of the upper section of the rectus abdominis muscles, which fleshes out the sharper, more angular costal cartilage of the thoracic arch. The top transverse intersection forms part of the upper border of the arch, giving a rounded quality to its form. Because classical Greek sculptors emphasized this arch in their figurative work, it is often referred to as the Greek arch.



Skeletal/anatomical arch. The green line shows the costal cartilage border of the ribcage.

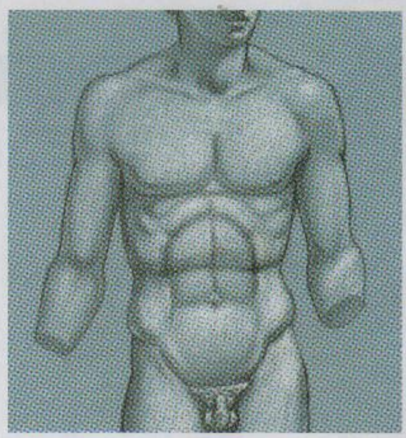


Rectus abdominis muscle. The red line shows the Greek arch; the green line shows the skeletal arch.

Skeletal (anatomical) arch

Greek (abdominal) arch

THORACIC ARCH CHARACTERISTICS



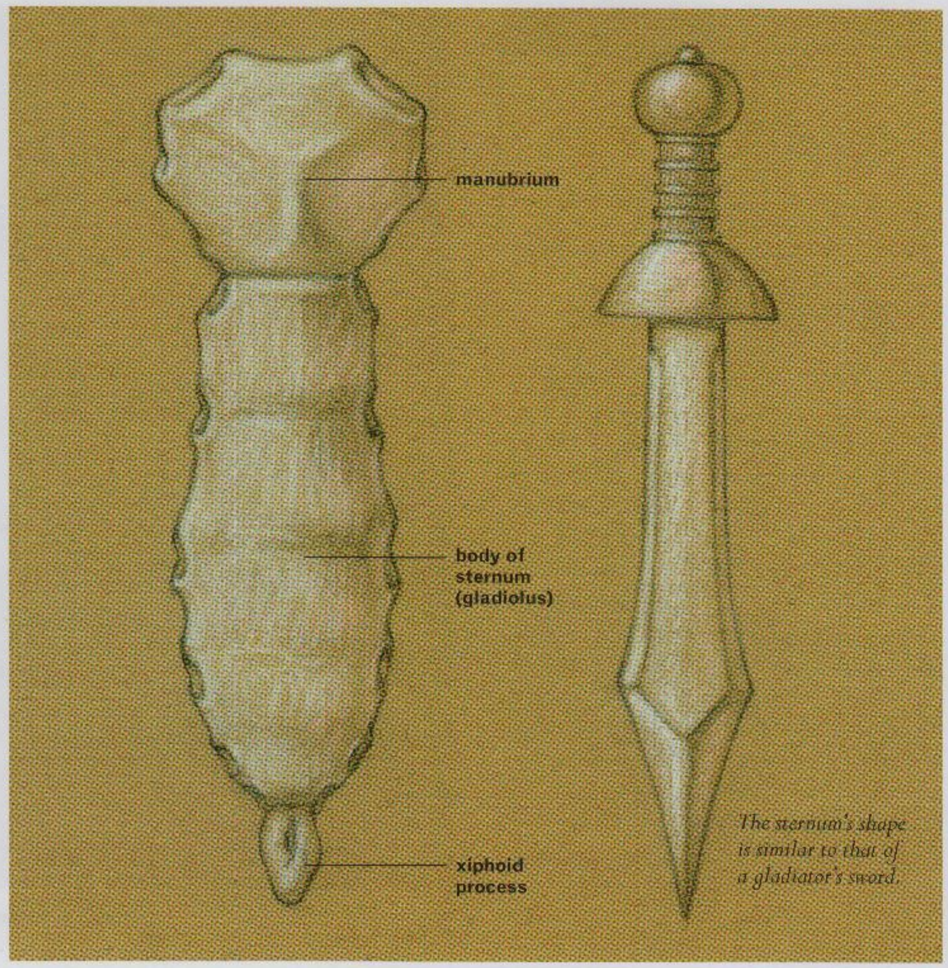
This study from a Greek sculpture shows the rounder quality of the abdominal arch.

Sternum

PRONOUNCIATION
STIR-num

ORIGIN OF THE TERM
Greek *sternon* = chest

SYNONYM
breastbone



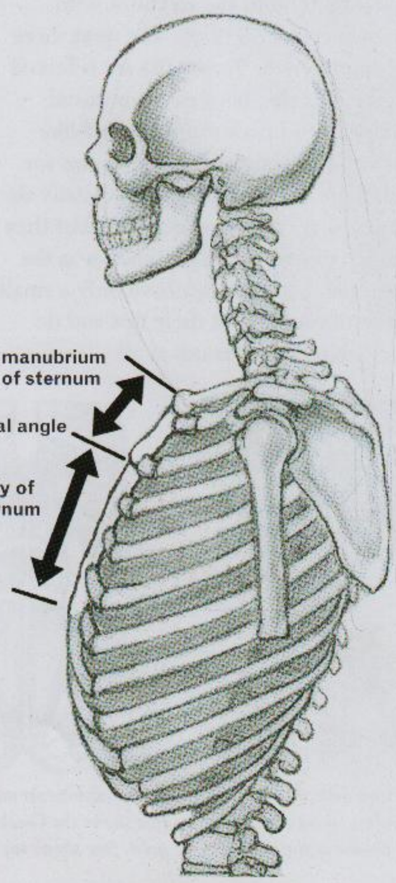
STERNUM (ANTERIOR VIEW)

Sternum

The sternum is the bony structure to which the ribs attach via cartilage. The sternum consists of three sections, or portions, that together create a shape similar to that of a small sword or a necktie. The *manubrium* (the "handle" of the sword shape) is the top section, where the two medial (inner) ends of the clavicle bones are attached. The *body of the sternum* is the "blade," and the *xiphoid process* is the "point of the blade."

A subtle plane change—a change of direction, really—occurs where the manubrium joins the body of the sternum. The ridge at this articulation is called the *sternal angle* (or *angle of Louis*).

The sternum establishes the central axis of the ribcage and is an essential landmark in front views of the torso. Its location, vertically dividing the muscular forms of the chest, serves as a visual guide to identifying any rotation or tilting that occurs when the figure is viewed in a given pose.



STERNAL ANGLE

The Three Sections of the Sternum

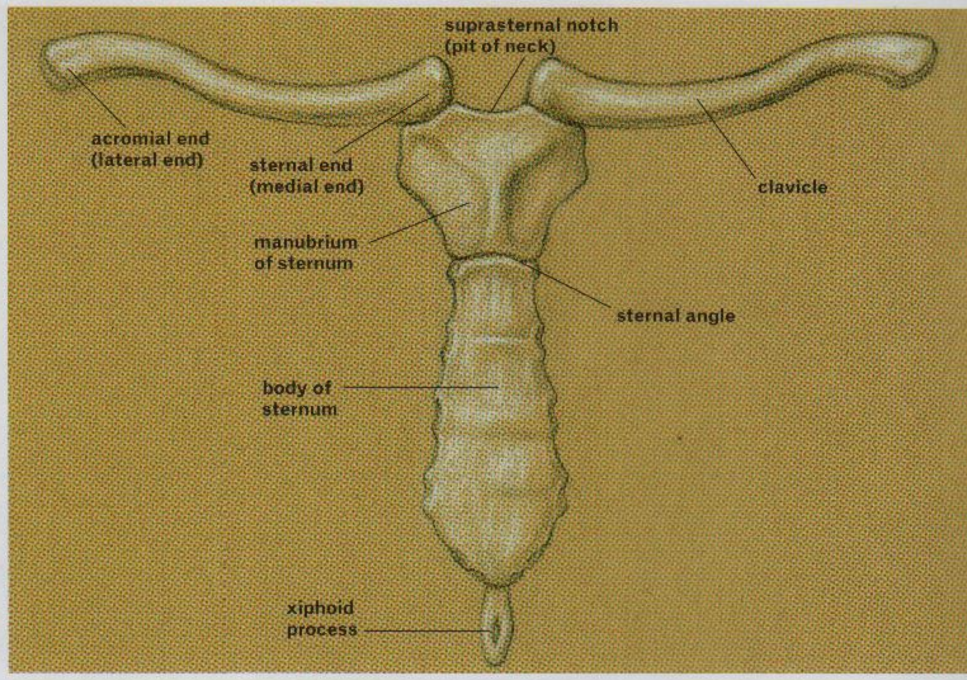
SECTION	ORIGIN OF TERM	SYNONYMS
Manubrium (maa-NEW-bree-um)	Latin *manubrium* = handle.	manubrium sterni (TA), manubrium of sternum, presternum
Body of Sternum, or Gladiolus	Latin *gladius* = sword	corpus sterni (TA), mesosternum
Xiphoid Process (ZIH-foid)	Greek *xiphos* = swordlike	processus xiphoideus (TA), ensiform process, process ensiformis, xiphisternum, xiphoid cartilage, xiphoid appendix, metasternum

Clavicles

PRONOUNCIATION
KLAV-ih-kul(s)

ORIGIN OF THE TERM
Latin *clavicula* = a small key

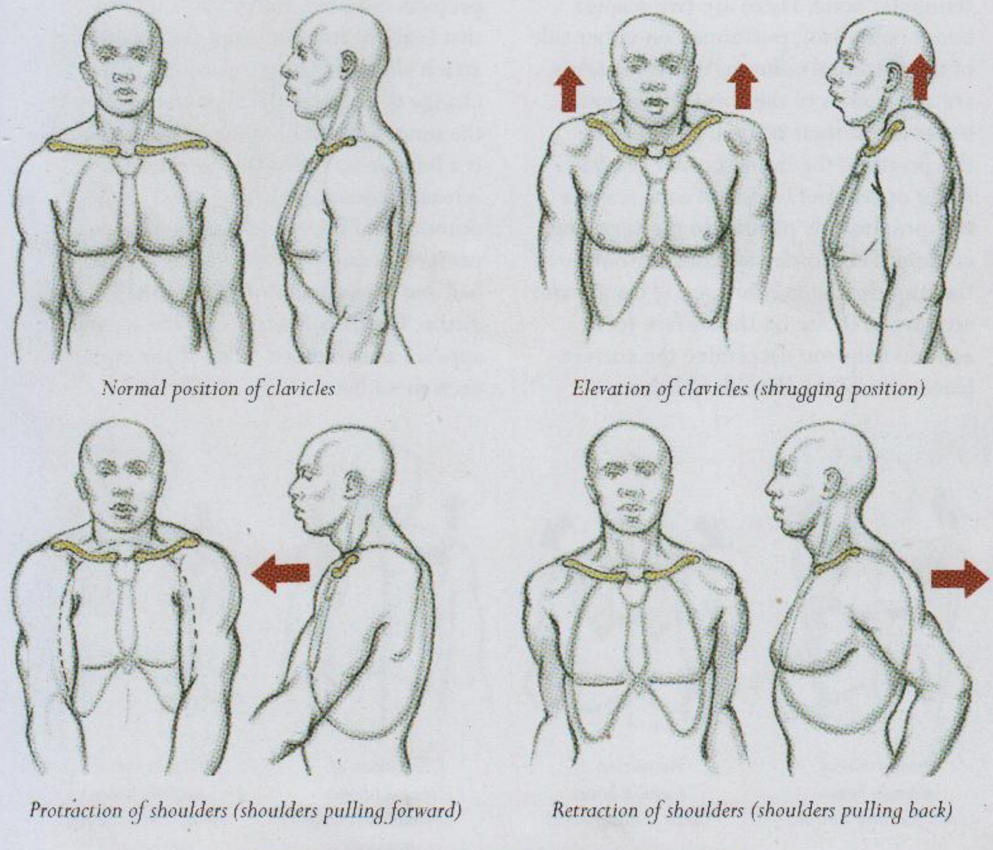
SYNONYMS
clavicula (TA [sing.]), collarbones



CLAVICLES WITH STERNUM

Clavicles

Each of the two clavicles, or collarbones, is an elongated bone with a slight twist that creates a subtle S shape when viewed from above. The inner (medial or sternal) ends of the collarbones are separated by a notch-like space, called the pit of the neck, suprasternal notch, or jugular notch, which is situated at the top of the sternum. The outer (lateral or acromial) end of each clavicle is joined to the acromion of the scapula. The outer end of each clavicle is more angular than the inner portion, which tends to be more cylindrical. When seen from above, the two clavicles together have a shape like that of a cupid's bow.



Normal position of clavicles

Elevation of clavicles (shrugging position)

Protraction of shoulders (shoulders pulling forward)

Retraction of shoulders (shoulders pulling back)

MOVEMENT OF CLAVICLES AND SHOULDER REGION

MOVEMENT OF CLAVICLES AND SHOULDER REGION

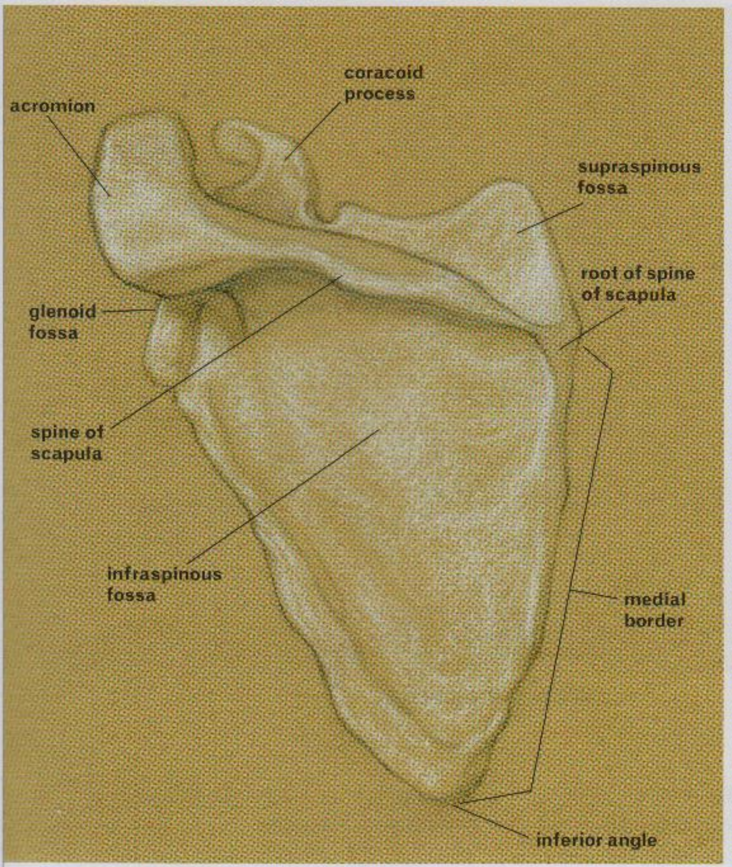
The clavicles can move together as a unit, as when someone swivels his or her shoulders, or independently, as when one lifts one shoulder upward while pushing the other forward. The pit of the neck is a useful landmark because it is located at the intersection of the sternum (the midline of the chest) and the clavicles (the axis of the shoulders)—the two major alignments to look for when setting up the torso. It also serves as the pivot point for the action of the neck.

Normal position of the clavicles. When the arms are at the side of the torso, the clavicles are in a normal position, which appears as a slight rise from the pit of the neck to the outer ends of the clavicles.

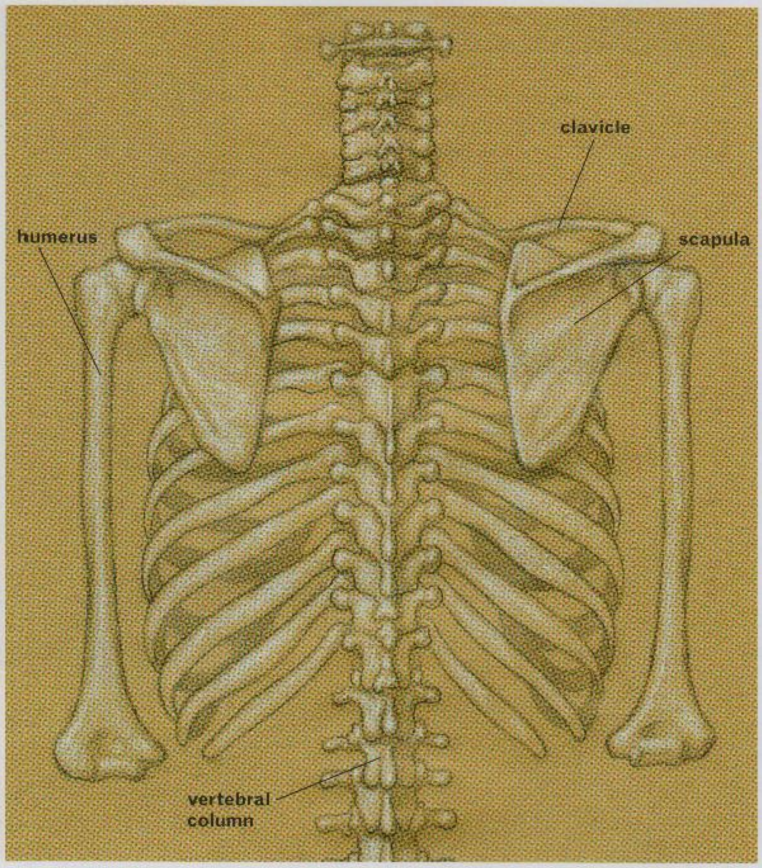
Elevation of the clavicles (shrugging position). When the shoulders are pushed upward in a shrug, the clavicles noticeably tilt upward. This acute angle of the collarbones also occurs when the arms are raised over the head.

Protraction of the shoulders (shoulders pulled forward). When the arms are pulled forward, the outer ends of the clavicles (as well as the ends of the shoulders) are also pulled forward to a position slightly in front of the ribcage.

Retraction of the shoulders (shoulders pulled back). When the arms reach behind the torso or the elbows are jabbing back, the outer ends of the clavicles extend slightly backward.



SCAPULA (POSTERIOR VIEW, LEFT SIDE)



SCAPULA BONES—NORMAL POSITION ON RIBCAGE (POSTERIOR VIEW)

Scapula Bones (Scapulae)

PRONOUNCIATION
Singular *scapula*: SKAP-yoo-lah
Plural *scapulae*: SKAP-yoo-lee

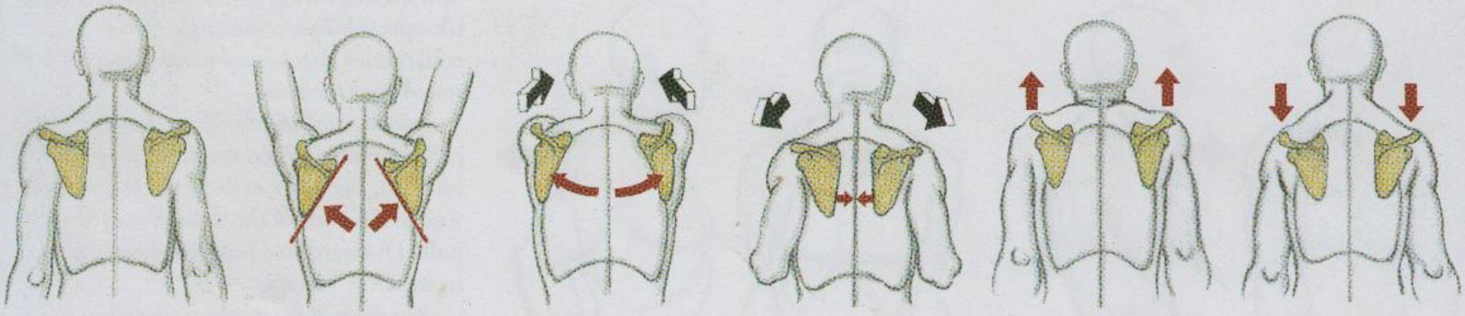
ORIGIN OF THE TERM
Latin *scapula* = shoulder blade

SYNONYMS
shoulder blades,
blade-bones, omoplates

Scapula Bones (Scapulae)

The scapula is a slightly elongated, triangular bone. There are two scapula bones (scapulae), positioned on either side of the vertebral column. When the arms are at the sides of the torso, the scapula bones are in their normal position. In this position, the inside border (*medial border* or *vertebral border*) of each scapula is approximately parallel to the vertebral column. This border and the bottom tip of the scapula (the *inferior angle of the scapula*) are easy to locate on the surface form and can help you determine the correct placement of the shoulder blades.

Near the top of the scapula is a bony ledge, called the *spine of the scapula,* that projects outward, much like a wave that is about to crest. Important muscles attach along this ridge, causing a plane change to occur in the shoulder girdle. At the outer end of the spine of the scapula is a bony mass called the *acromion* (or *acromial process*), which is joined to the outer end of the clavicle and serves as a protective canopy over the vulnerable ball and socket joint of the shoulder girdle. On the surface form, the acromion appears as a rounded ledge at the end of each shoulder.



Normal position of scapula bones

Upward rotation of scapula bones

Protraction of scapula bones (arms pushing forward)

Retraction of scapula bones (arms pulling back)

Elevation of scapula bones (shoulders lifting upward)

Depression of scapula bones (shoulders pushing downward)

MOVEMENT OF SCAPULA BONES AND SHOULDER REGION

The *glenoid fossa* (or *glenoid cavity*) is a small, pear-shaped depression on the outer side of the scapula. This is the socket into which the ball-shaped head of the humerus bone fits.

The *coracoid process* is a projection of bone that serves as an attachment site for muscles. The *supraspinous fossa* is a depression nestled above the spine of the scapula, while the *infraspinous fossa* is the valley-shaped depression below the spine of the scapula.

MOVEMENT OF THE SCAPULA BONES AND SHOULDER REGION

When the arms move, the scapula bones move, as well. Depending on the placement of the arms, the scapula bones will tilt, roll forward on the ribcage, move toward the spinal column, or move upward or downward.

When the shoulder blades change positions, the muscles attached to them stretch or compress, causing the topography of the upper back to change dramatically. When analyzing the forms of the back, you should first look for three things: the placement of the ribcage, the position of the spinal column, and the placement of the shoulder blades. Once you have determined these placements and positions, it becomes easier to determine the general location of the muscular forms and how their shapes relate to one another and to the bones beneath.

Normal position of the scapula bones. The inside borders of the scapula bones are almost parallel to the vertebral column when the arms are at the side of the torso.

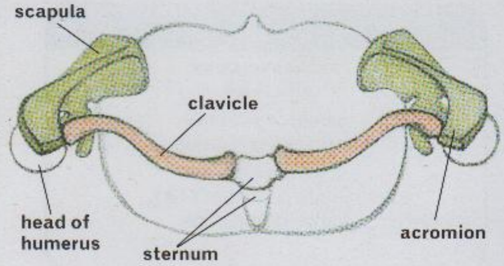
Upward rotation of the scapula bones. When the arms are lifted upward, the scapula begins to rotate and tilt. The inside border is no longer parallel to the vertebral column but is at a noticeable angle.

Protraction of the scapula bones. When the arms or shoulders push forward, the scapula bones roll over the ribcage, away from the vertebral column. This movement is known as protraction or, sometimes, abduction.

Retraction of the scapula bones. When the arms or shoulders are pulled back, the scapula bones move closer to the vertebral column. This movement is known as retraction or, sometimes, adduction.

Elevation of the scapula bones. When the shoulders push upward into a shrug, the scapula bones are pushed upward, as well.

Depression of the scapula bones. The scapula bones are depressed (moved downward) as they return to their normal position after being elevated, but the term *depression of the scapula bones* also refers to the bones being pulled noticeably downward, as when the arms are holding a heavy weight or, for example, when a gymnast straightens his or her arms on the parallel bars.

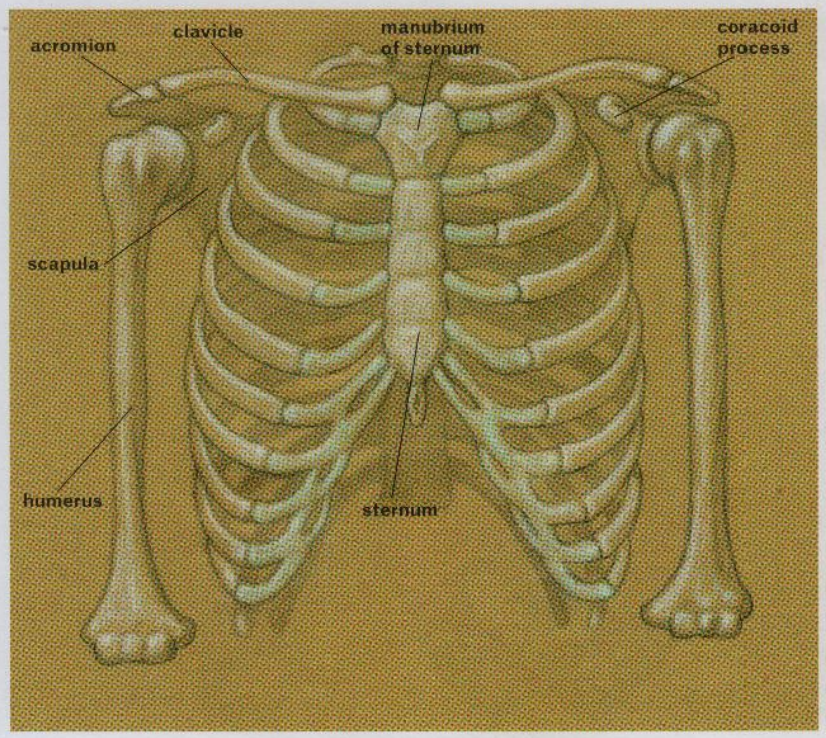


SHOULDER GIRDLE (SUPERIOR VIEW)

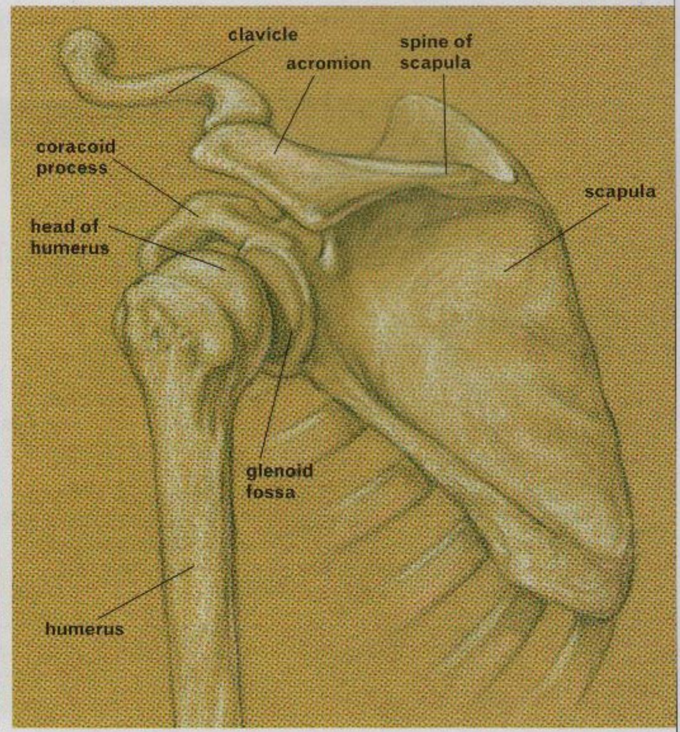
Shoulder Girdle

The shoulder girdle comprises the clavicles, the scapula bones, and the manubrium of the sternum. On each side, the acromion of the spine of the scapula is joined to the outer end (lateral end) of the clavicle. The medial ends of the clavicles are attached to the sternum in the front of the ribcage. This creates an almost continuous bony arch encircling the ribcage from back to front.

The outer end of each clavicle is a little higher than bony ledge of the acromion, which appears as a slight drop on the outer region of the shoulder. The shoulder changes shape depending on the placement of the upper arm, appearing rounded when influenced by the humerus or as a distinct flat plane when influenced by the bony ledge of the acromion.



SHOULDER GIRDLE (ANTERIOR VIEW)



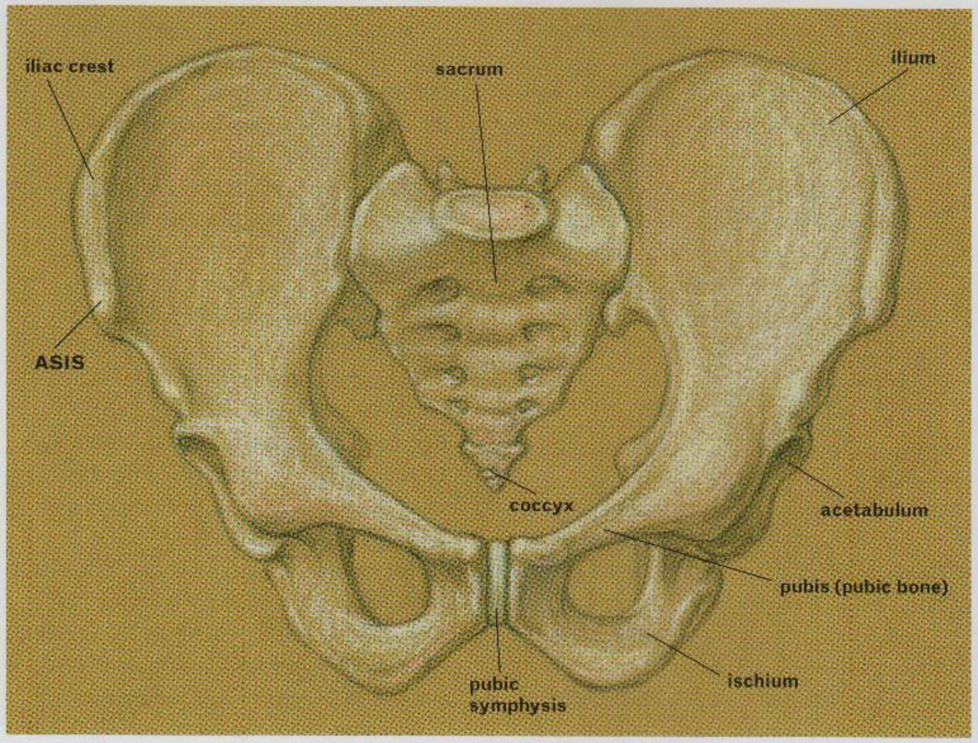
SHOULDER GIRDLE (LATERAL VIEW, LEFT SHOULDER)

Pelvis

PRONOUNCIATION
PEL-viss

ORIGIN OF THE TERM
Latin *pelvis* = basin

SYNONYMS
cingulum pelvicum (TA), pelvic girdle, hips



PELVIS (ANTERIOR VIEW)

Pelvis

The pelvis comprises the two *hip bones,* which are positioned on either side of the single *sacrum* bone. These three bones together form a single unit and do not move independently of each other.

Each hip bone consists of three fused bones: the *ilium,* the *ischium,* and the *pubis.* Each of the two ilium bones has large, winglike shapes that curve toward the front. These sweeping forms resemble bowls, or basins, and give the pelvis its name. (*Pelvis* means "basin" in Latin.) The top ledge of each ilium bone is known as the *iliac crest* and is noticeable on some figures, especially lean or athletic types. The front end of the iliac crest creates a small bump on the surface form. This bony protrusion is called the *anterior superior iliac spine,* or *ASIS.* The two ASIS protrusions, one on each side of the pelvis, are important landmarks; their placement will help you assess the angle or tilt of the pelvis. Because several muscles cover the pelvis, its precise location can be difficult to determine. Observing the ASIS bumps (in front views) will help reveal where the pelvis is located under the surface forms.

At the other end of the iliac crest (toward the back) is another useful landmark, called the *posterior superior iliac spine,* or *PSIS.* At the junction of the sacrum and each PSIS, an indentation, or dimple, shows on the surface form. These two little depressions provide another clue for locating the elusive pelvis. By drawing an imaginary line connecting these two dimples along the top border of the sacrum, you can evaluate the degree of tilting or rotation occurring in the pelvis.

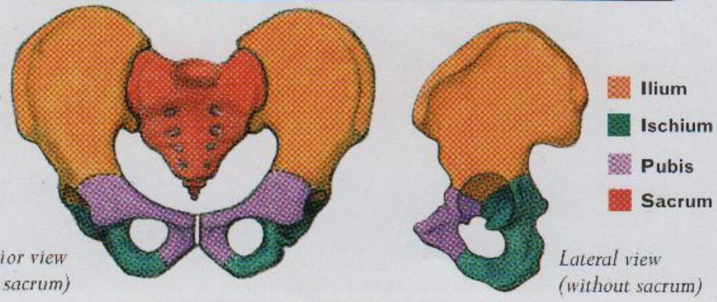
The *ischium bones* are the two bagel-like forms of the lower part of the pelvis. Along the lower part of each ischium bone, on the posterior side, is a textured roughness on the bone surface called the *ischial tuberosity.* It serves as an attachment site for certain leg muscles. The strong bony structure of the ischium helps support the body's weight in a sitting position. These bones are not evident on the surface form because they are covered by the gluteus muscles.

The Three Sections of the Whole Pelvis

SECTION	ORIGIN OF TERM	SYNONYMS
Hip Bone (pair)	—	os coxae (TA), coxal, os innominatum, innominate bone, pelvic bone, pelvis bone, haunch bone, coxa
Sacrum (SAY-crum)	Latin *sacrum* = sacred	os sacrum (TA), vertebrae sacrales (TA), sacral triangle, triangle bone of pelvis, sacral vertebrae
Coccyx (KOCK-six)	Greek *kokkux* = cuckoo (because of its resemblance to a cuckoo's beak)	vertebrae coccygeae (TA), os coccygis (TA), tailbone, coccygeal vertebrae

The Three Sections of Each Hip Bone

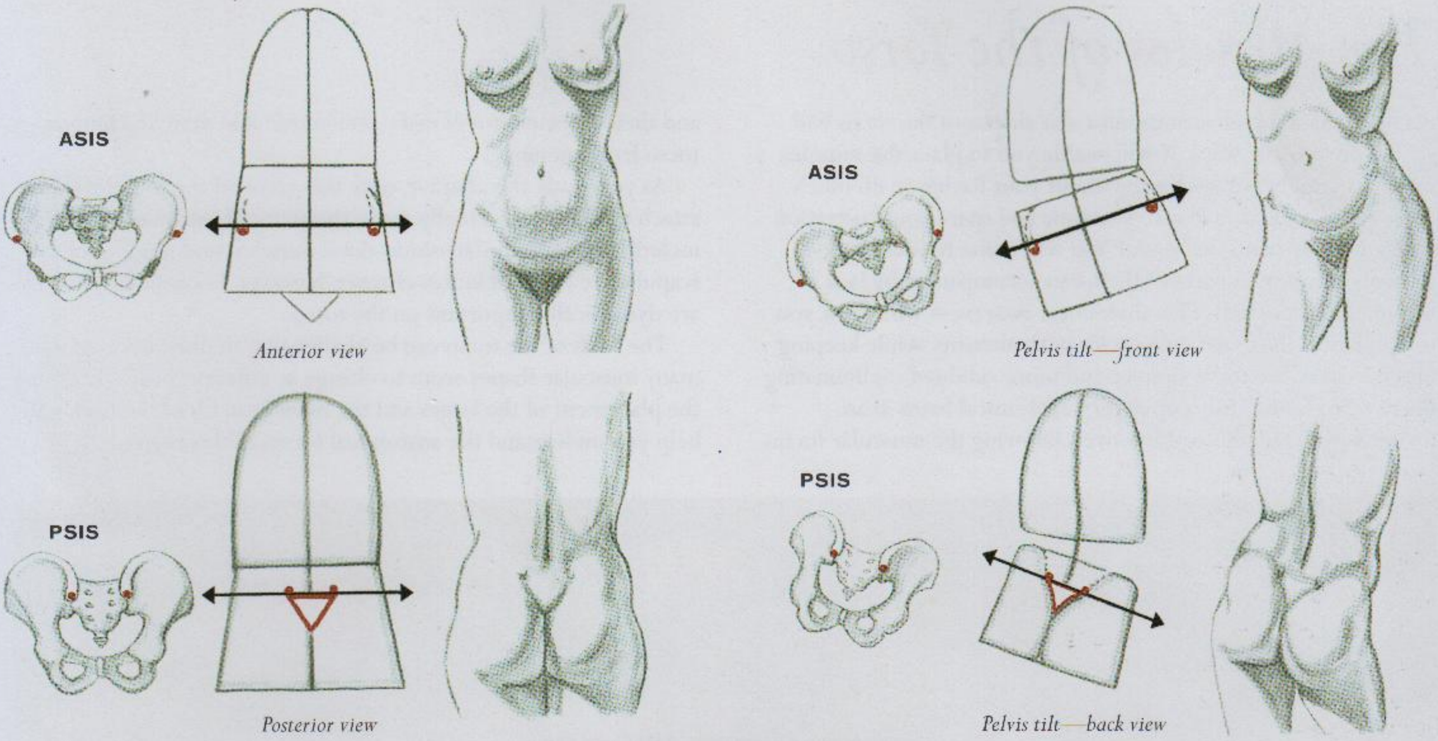
SECTION	ORIGIN OF TERM	SYNONYMS
Ilium (ILL-ee-um)	Latin *ilium* = groin, flank	os ilium (TA), iliac bone, flank bone
Ischium (ISS-kee-um)	Greek *ischion* = hip joint	os ischii (TA), ischial bone, sits bone, sitz bone, seated bones
Pubis (PYOO-biss)	Latin *pubes* = adult	os pubis (TA), pubic bone, bone of the groin



Anterior view (with sacrum)

Lateral view (without sacrum)

HIP BONES—THREE SECTIONS (AND SACRUM)



PELVIC LANDMARKS—ASIS AND PSIS

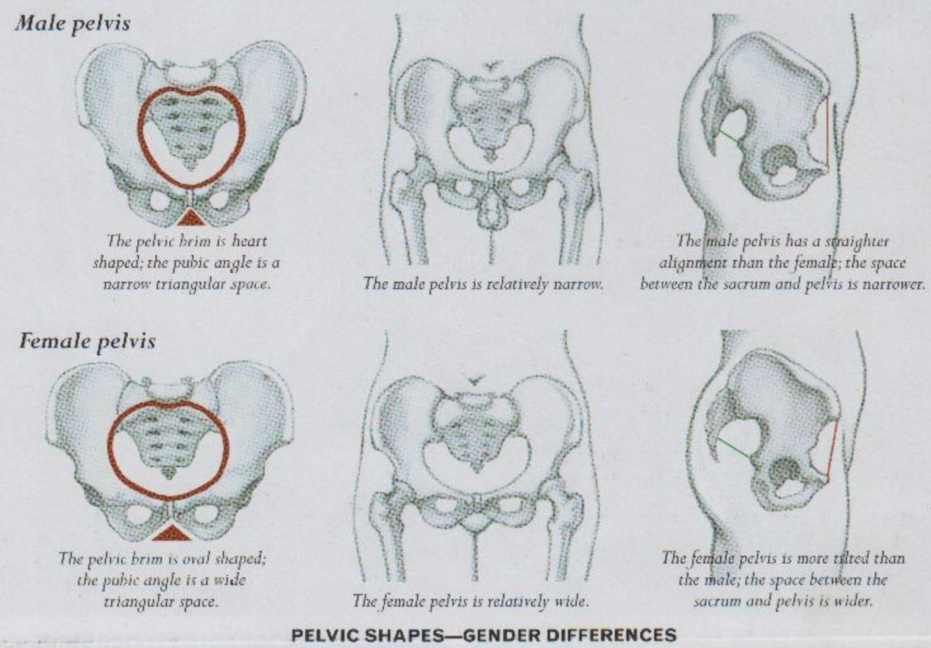
The two bones of the *pubis,* commonly called the pubic bones, form a bony ledge in the front of the pelvis. They are joined by a small fibrocartilage disc called the *pubic symphysis.* Located above the genital area, this bony bridge is not visible on the living figure because it is covered with muscle, fatty tissue, skin, and hair, but its position serves as a proportional landmark. The horizontal line formed by the pubic bones is called the *anatomical center* because it divides the standing figure in half, from the top of the cranium to the bottoms of the feet. The pubic bones are an essential attachment site for the abdominal and leg muscles.

The three sections of the hip bone (ilium, ischium, and pubis) meet in the center of a cuplike socket called the *acetabulum.* This is the location of the ball and socket joint of the pelvis and femur (upper leg bone).

The *sacrum* (or *sacral triangle*) is a triangular bone at the base of the vertebral column that also serves as the central portion of the pelvis. The bottom end of the sacrum is located just above the point where the gluteus maximus muscles (the buttocks) split vertically. The small PSIS dimples mentioned earlier form the other two points of the sacral triangle. This triangular shape is a significant landmark because it provides evidence of how the pelvis is positioned in a particular pose. The *coccyx* (tail bone), at the bottom tip of the sacrum, is rarely seen on the living figure because the gluteus muscles usually conceal it from view.

PELVIS—GENDER DIFFERENCES

Anatomically, there are some differences between the male and female skeletal structure, and the most obvious of these is the form of the pelvis. Women generally have wider hips than men. When a woman is pregnant, her broader pelvis cradles the growing fetus and allows for easier passage of the baby through the birth canal. The female pelvic brim, or inlet (the circular opening of the pelvis), is oval shaped, whereas the male pelvic brim is narrower and heart shaped. The female sacrum is shorter and wider than the male sacrum and does not curve inward as much. Finally, the pubic angle (the space between the ischium bones) is wider in the female pelvis than in the male pelvis.



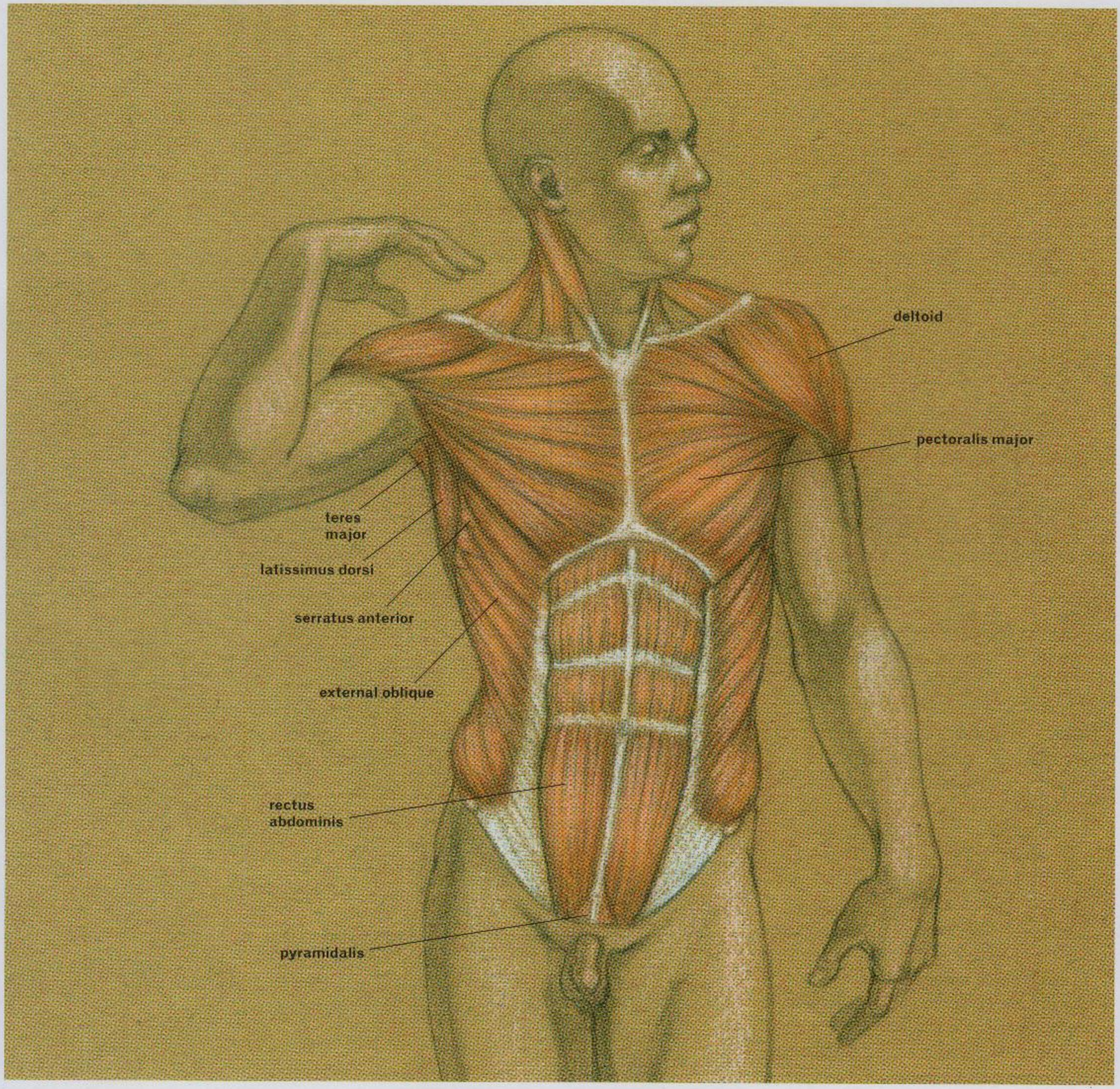
PELVIC SHAPES—GENDER DIFFERENCES

The Muscles of the Torso

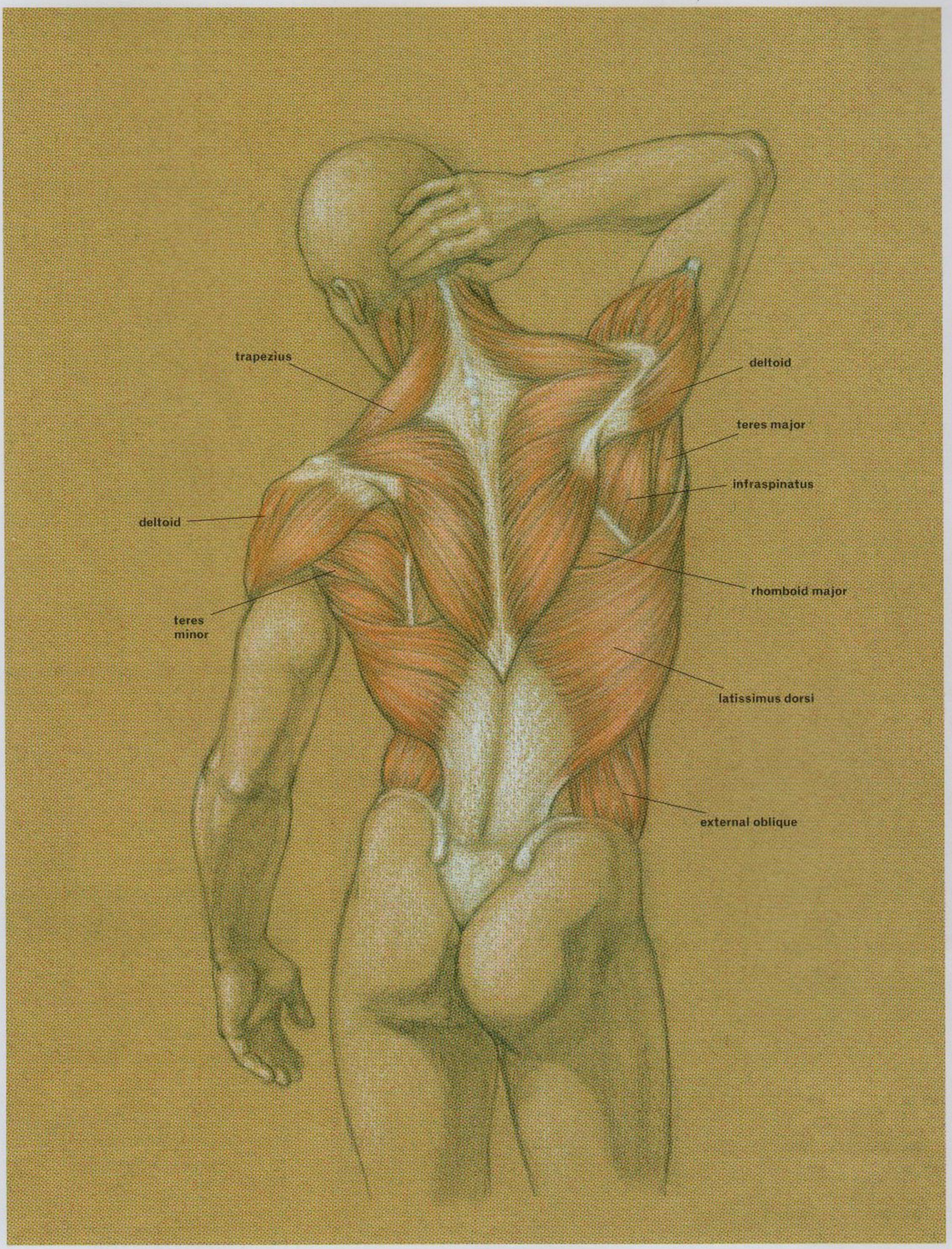
An understanding of various muscular shapes of the torso will serve you in many ways. It will enable you to place the muscles more accurately as you draw, without your having to do much guesswork—which will save you time and spare you frustration when drawing from the model. You will come to recognize muscular tension in parts of the torso accompanied by lack of tension in other parts. This anatomical awareness will allow you to emphasize the dynamic muscles with intensity while keeping other areas of the torso simpler and more subdued—eliminating the need to fastidiously copy every anatomical form in an excessively detailed way. Moreover, knowing the muscular forms and their placement will make you better able draw the human torso from memory.

As you study this chapter, note that some of the muscles that attach on the torso actually move the arms. These muscles, which include the deltoids, latissimus dorsi muscles, and muscles of the scapula, are covered in this chapter, however, because their forms are dynamically important on the torso.

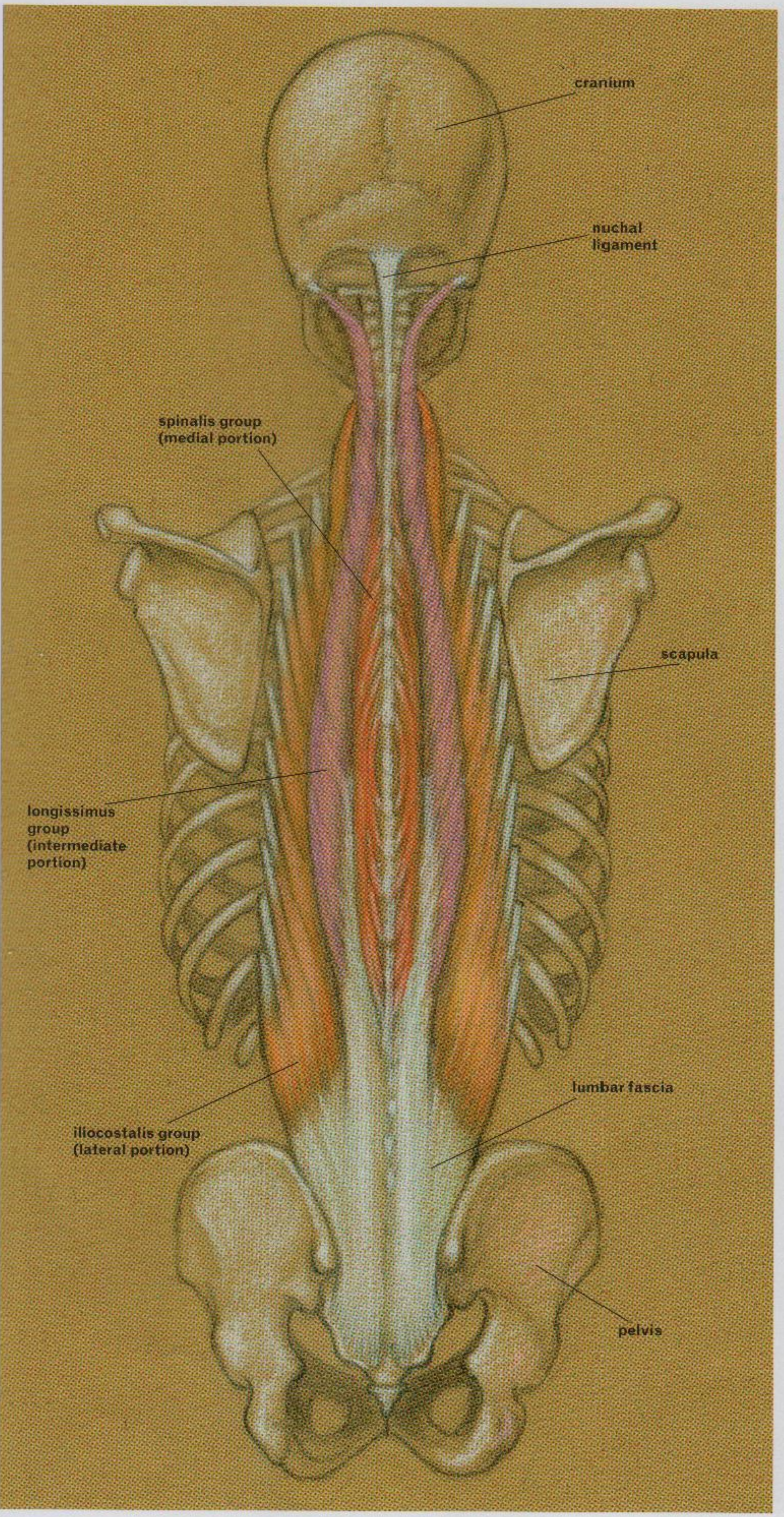
The back of the torso can be challenging to draw because the many muscular shapes seem to change in different poses. Learning the placement of the bones and the main muscles of the back will help you understand the anatomical forms of this region.



MUSCLES OF THE TORSO (ANTERIOR VIEW)



MUSCLES OF THE TORSO (POSTERIOR VIEW)



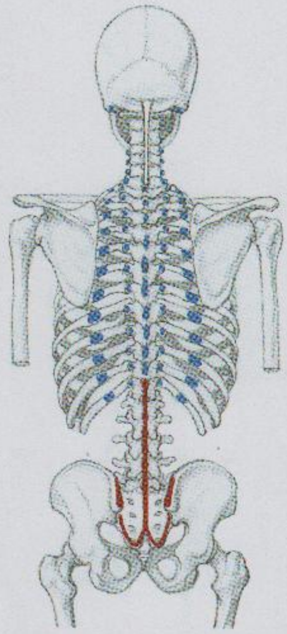
SACROSPINALIS (POSTERIOR VIEW)

Sacrospinalis

PRONOUNCIATION
SAY-kro-spih-NAL-iss
or
SAY-kro-spy-NAY-liss

ORIGIN OF THE TERM
Latin *sacro* = sacral + *spina* = thorn, spine

SYNONYMS
musculus erector spinae (TA), erector spinae



SACROSPINALIS—MUSCLE ATTACHMENTS

ORIGIN
- sacrum
- posterior end of iliac crest of pelvis
- lower seven vertebrae (spinous processes)

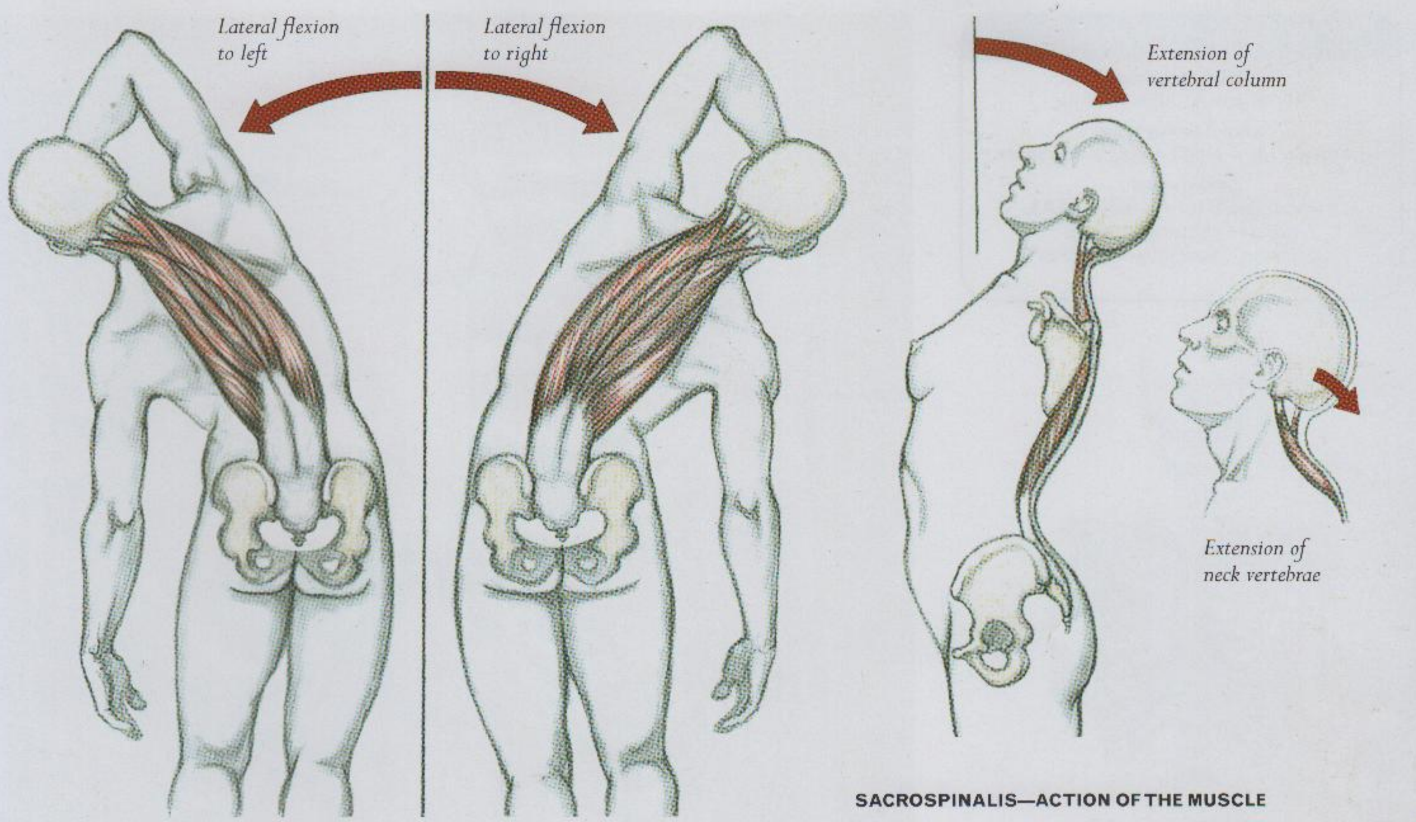
INSERTION
- angle of ribs
- spinous and transverse processes of thoracic and cervical vertebrae
- mastoid process of cranium

The Three Groups of Sacrospinalis

LATERAL PORTION
Iliocostalis Group
PRONOUNCIATION IL-ee-oh-kos-TAY-liss
ORIGIN OF TERM Latin *ilio* = ilium + *costa* = rib
SYNONYMS musculus iliocostalis (TA), iliocostal muscle

INTERMEDIATE PORTION
Longissimus Group
PRONOUNCIATION long-GISS-ih-muss *or* long-JISS-ih-muss
ORIGIN OF TERM Latin *longissimus* = longest
SYNONYM musculus longissimus (TA)

MEDIAL PORTION
Spinalis Group
PRONOUNCIATION spih-NAY-liss *or* spy-NAY-liss
ORIGIN OF TERM Latin *spina* = thorn, spine
SYNONYM musculus spinalis (TA)



SACROSPINALIS—ACTION OF THE MUSCLE

Sacrospinalis

The sacrospinalis, which is also referred to as the *erector spinae,* is the muscle that keeps the spine erect. It is a deep-layer muscle that forms two large muscular columns on either side of the vertebral column, from the sacrum to the skull.

The sacrospinalis is a vastly complex muscle structure. Each of its columns, on either side of the vertebral column, divides into three groups of muscle, called the *iliocostalis,* the *longissimus,* and the *spinalis.*

At the pelvis, the broad, thick tendon called the *lumbar fascia* begins at the sacrum, the iliac crest of the pelvis, and the spinous processes of the lower seven vertebrae (all five lumbar vertebrae and the two lowest thoracic vertebrae). Near the lower ribs, the sacrospinalis begins to divide into the three groups and to further subdivide into multiple components attaching along the ribs, the thoracic and cervical vertebrae, and the mastoid process of the skull.

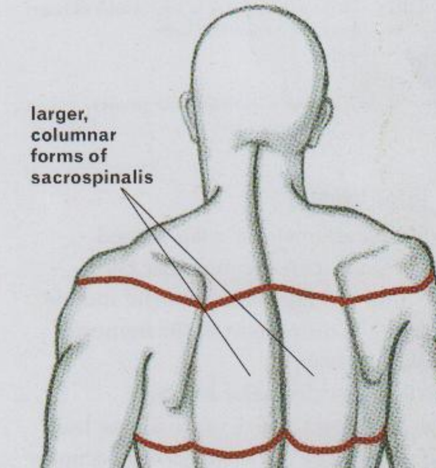
It is not usually possible to see these multiple, divided groups on the surface form because they tend to blend together as massive cylindrical shapes on either side of the spine. The muscle does influence the surface of the back, however, even though it lies beneath the latissimus dorsi, the rhomboids, and the trapezius muscles. The most noticeable part of the sacrospinalis is the two smaller (but prominent) columnar forms of the lumbar region, just above the sacrum bone. This is an essential landmark because it can show tension in the back in certain poses. Also, these shapes can be used as transitional forms between the ribcage and pelvis.

ACTION OF THE MUSCLE

A main function of the sacrospinalis is to maintain the vertebral column in an erect position. When the muscle on both sides of the spine contracts, it bends the vertebral column backward in the movement known as either extension or hyperextension. When the figure is bending forward at the waist (flexion) and then returns to the erect standing position, this movement is also considered extension.

When the upper fibers of the sacrospinalis contract, then the head and the cervical vertebrae (neck) will bend back, but not the ribcage.

Lateral flexion (side bending) occurs when one side of the sacrospinalis muscle contracts and the torso bends to the side.



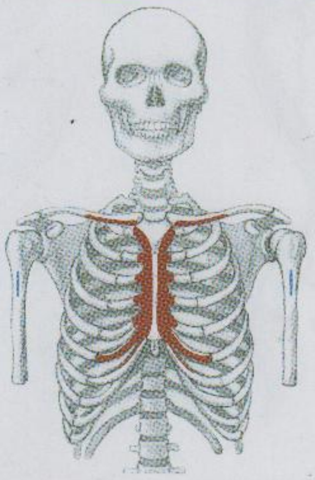
CONTOURS OF THE BACK

Pectoralis Major

PRONOUNCIATION
PECK-tor-AL-liss MAY-jur

ORIGIN OF THE TERM
Latin *pectus* = chest + *major* = greater

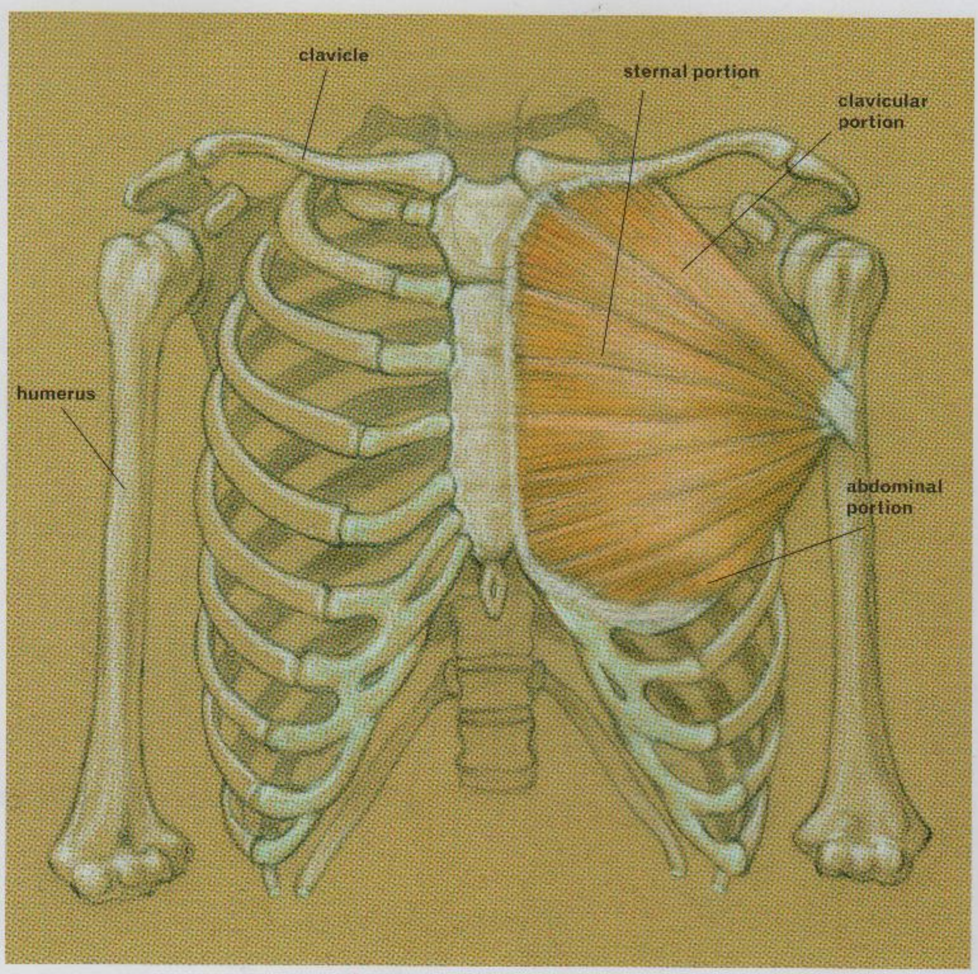
SYNONYMS
musculus pectoralis major (TA), greater pectoral muscle, pectorals, chest muscle, "pecs"



PECTORALIS MAJOR—MUSCLE ATTACHMENTS

ORIGIN
- clavicle (one-half length on medial side)
- sternum (entire length on outer or lateral sides of bone)
- costal cartilages of first six or seven ribs
- abdominal sheath

INSERTION
- humerus (lateral lip of inter-tubercular groove)



PECTORALIS MAJOR

Pectoralis Major

The pectoralis major is a fan-shaped muscle that forms the muscular chest wall of the ribcage. This powerful muscle assists in the movement of the humerus (upper arm bone).

The pectoralis major has three portions, two of which make up the bulk of the chest. The *clavicular portion* occupies nearly half the length of the clavicle (hence the name) at the medial and front edges of the bone. The *sternal portion* attaches along the entire outer length of the sternum (breastbone), as well as on the front (anterior) side of the costal cartilages of the first six or seven ribs. The third portion, recognized by some anatomists, is called the *abdominal portion*. Usually hard to see on the live model, the abdominal portion can occasionally be detected on cadavers and écorché studies, looking as if it were an extra digitation of the external oblique muscle. Ordinarily, however, the abdominal portion is blended with the sternal portion and shows no evidence on the surface form.

The clavicular and sternal portions of the pectoralis major pull across the ribcage to taper into a flat tendon that twists before it inserts into the humerus at the *lateral lip of the inter-tubercular groove*. The clavicular portion crosses over in front of the sternal portion and attaches downward on the humerus, while the sternal portion attaches a little higher up. This crisscrossing of fibers allows for greater mobility of the arm. When the arms are at the side of the torso, the insertions of the pectoralis muscles cannot be seen on the surface because they are blocked by the arms' cylindrical shape. But when the arms begin to pull away from the torso, the points of attachment can be seen tapering into the arms. Each of these areas is called the front wall (or anterior wall) of the armpit, because the muscle is very thick at this location.

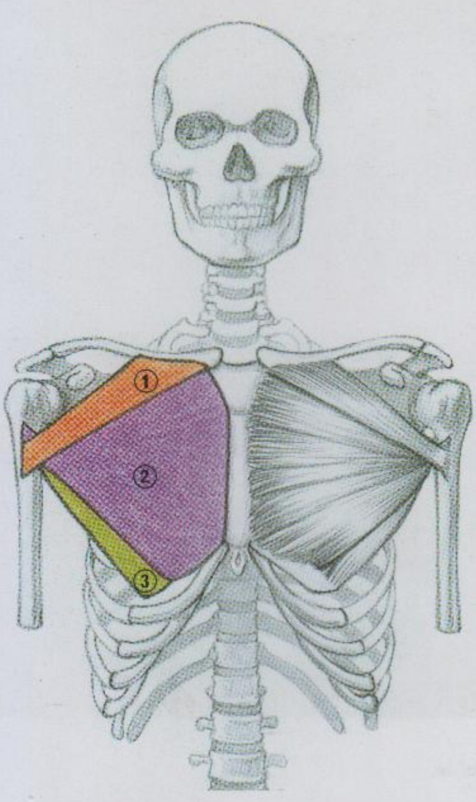
FEMALE AND MALE CHEST FORMS

On women, the mammary glands are attached to the fascia covering the pectoralis major, causing a fuller form in the lower region of the muscle. There are many shapes and sizes of the female breast, and these forms will alter depending on the action of the arms and the position of the torso.

On men, the chest forms are generally more angular in appearance. Near the bottom of the pectoralis muscle are fatty deposits, which give a fuller, more squared shape to the chest wall in this lower area.

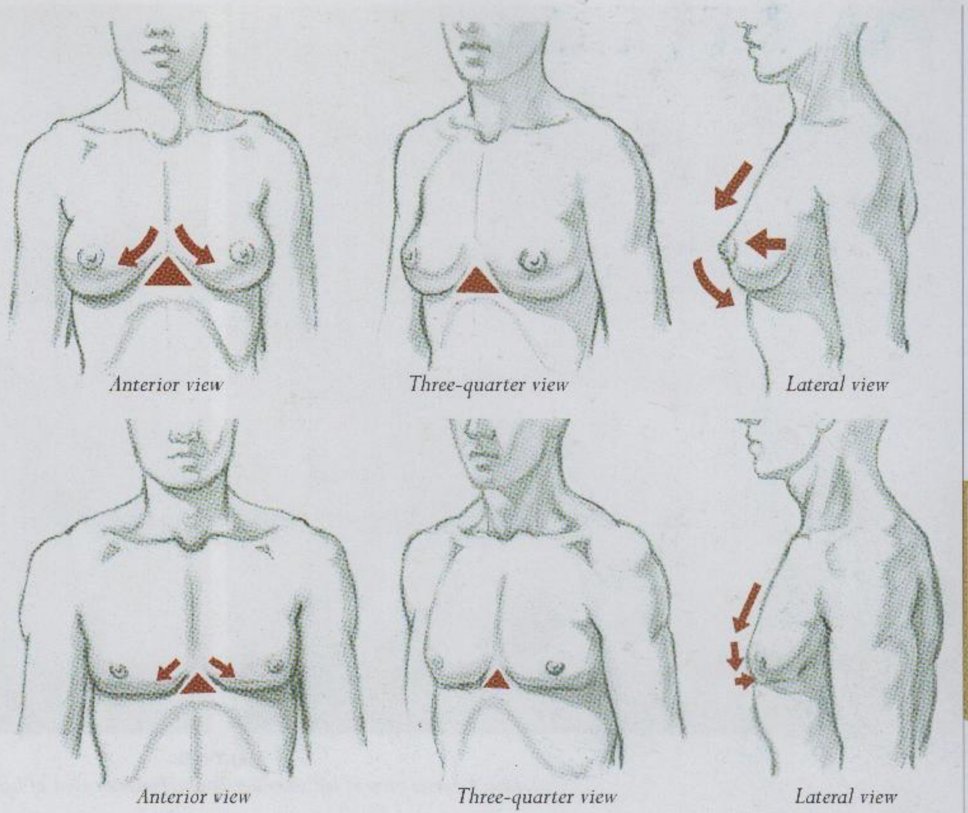
The nipple form is the small projection positioned slightly off center on the breast form. The areola is the pigmented circular area around the nipple. The forms of the nipples are generally smaller on men than on women and are positioned lower down on the pectoralis major. As the ribcage is rotated toward a profile view, the nipple area becomes more elliptical in appearance.

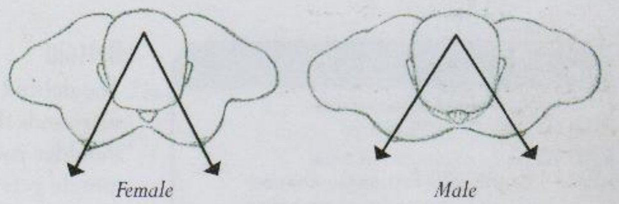
The triangular space at the base of the sternum, between the lower parts of the breast forms, is called the *epigastric fossa*.



THE THREE PORTIONS OF THE PECTORALIS

1. clavicular portion
2. sternal portion
3. abdominal portion





Top: **FEMALE CHEST FORM**

Middle: **MALE CHEST FORM**

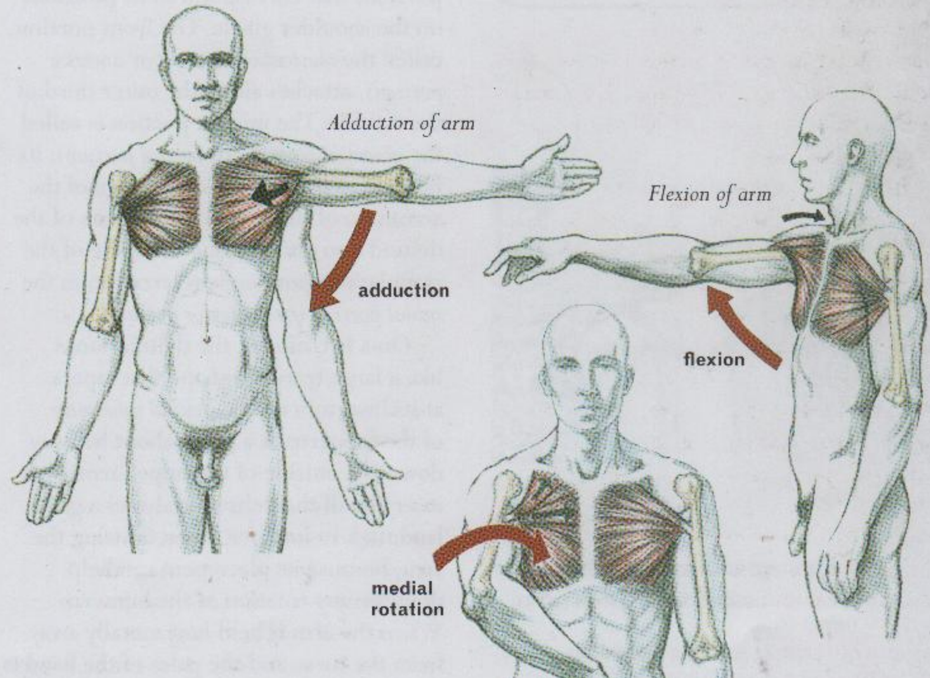
Bottom: **CHEST FORMS—SUPERIOR VIEW**

It often appears larger on women than on men, although this depends on the size and characteristics of the chest form. Highlights will sometimes catch in this triangular space, as well as along the breastbone.

ACTION OF THE MUSCLE

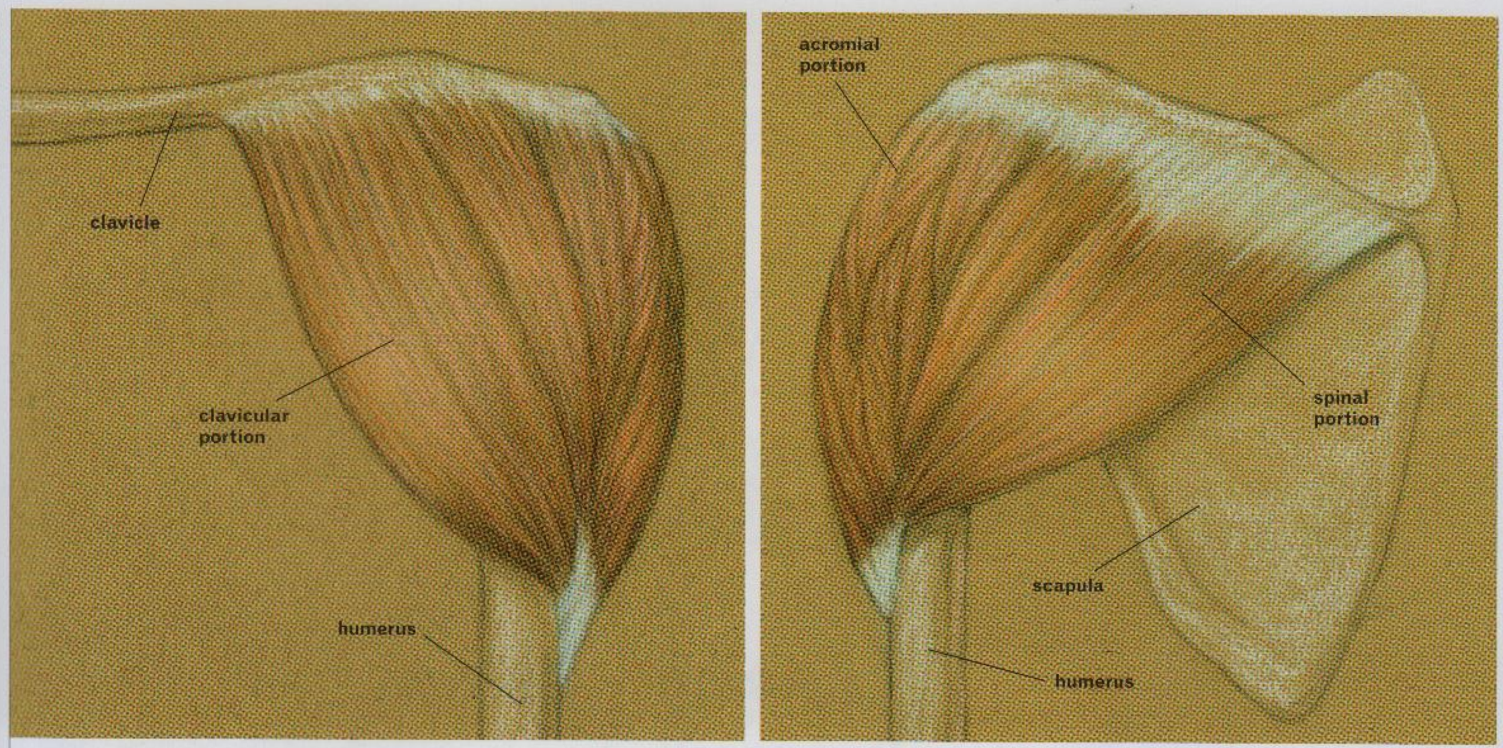
The main function of the pectoralis major is to move the arm to different positions. It is an incredibly strong muscle and assists in the actions of climbing, throwing, and pushing.

The clavicular portion contributes to the action of raising the arms in front of the torso (flexion). When the arms are positioned overhead or horizontally at the sides of the torso, the sternal portion helps return them to the normal position through the movement of adduction. When both the clavicular and the sternal portions of the pectoralis contract, they contribute to the movement of rotating the arm medially.



PECTORALIS MAJOR—ACTION OF THE MUSCLE

Black arrows indicate direction of muscular contraction; red arrows indicate movement of the limb.



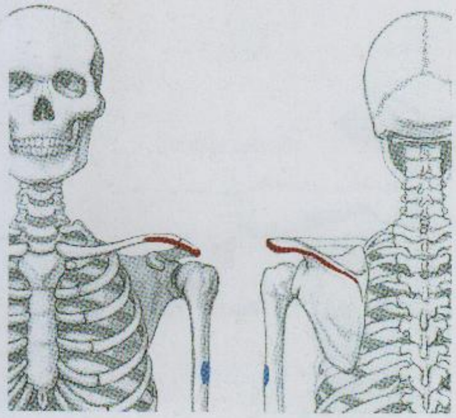
DELTOID
Left: Anterior view of left shoulder. Right: Posterior view of left shoulder.

Deltoid

PRONOUNCIATION
DELL-toyd

ORIGIN OF THE TERM
Greek *delta* = triangle-shaped fourth letter of Greek alphabet

SYNONYM
musculus deltoideus (TA)



DELTOID—MUSCLE ATTACHMENTS

ORIGIN (CLAVICULAR/ANTERIOR PORTION)
- clavicle (lateral third)

ORIGIN (ARCOMIAL/MIDDLE PORTION)
- acromion of spine of scapula (outer border)

ORIGIN (SPINAL/POSTERIOR PORTION)
- spine of scapula (lower border)

INSERTION
- humerus (deltoid tuberosity)

Deltoid

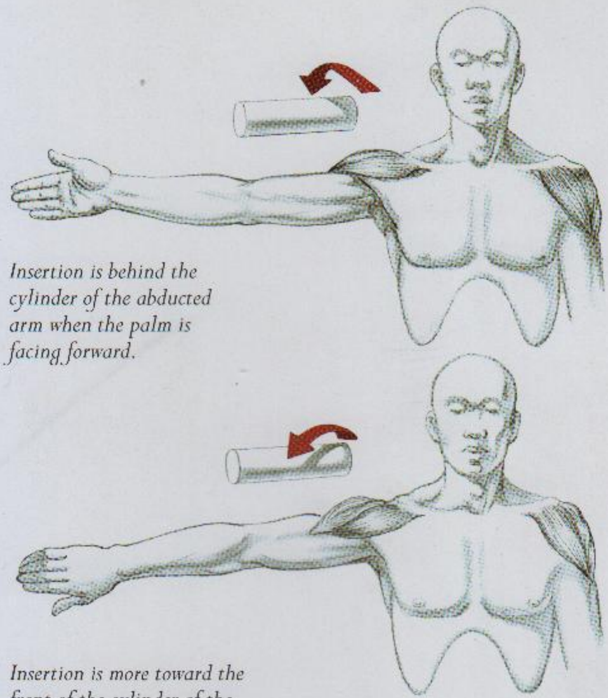
The deltoid is a triangular muscle that surrounds the shoulder somewhat like the shoulder pads of a football uniform. The muscle gets its name from the triangular shape of the Greek letter *delta*.

The deltoid is divided into three portions that correspond to its positions on the shoulder girdle. The front portion, called the *clavicular portion* (or *anterior portion*), attaches along the outer third of the clavicle. The middle portion is called the *acromial portion* (or *lateral portion*); its fibers attach along the outer edge of the acromion of the scapula. The fibers of the deltoid also attach along the spine of the scapula; this portion is referred to as the *spinal portion* (or *posterior portion*).

On a live model, the deltoid looks like a large teardrop shape that tapers at its insertion on the *deltoid tuberosity* of the humerus at a point about halfway down the outside of the upper arm. The insertion of the deltoid is always a good landmark to look for when drawing the arm, because its placement can help describe any rotation of the humerus. When the arm is held horizontally away from the torso and the palm of the hand is facing toward the front, the deltoid rolls over the cylindrical shape of the upper arm, and its insertion is on the other side, out of view. If the humerus is rotated medially with the palm facing backward, however, the point of insertion can be seen in the front part of the upper arm.

The muscle fibers of the three portions of the deltoid travel in slightly different directions, and these differences can at times be detected on the surface form when the muscle is tensed. The fibers of the clavicular (anterior) portion descend in parallel toward the insertion location. Those of the spinal (posterior) portion descend in a slightly spiraling direction from the spine of the scapula toward the insertion on the humerus. The fibers of the acromial (middle) portion have a *multipennate* form, which means that they are gathered in numerous bundles that consist of parallel fibers and interweaving oblique fibers, giving this portion of the deltoid a braided appearance.

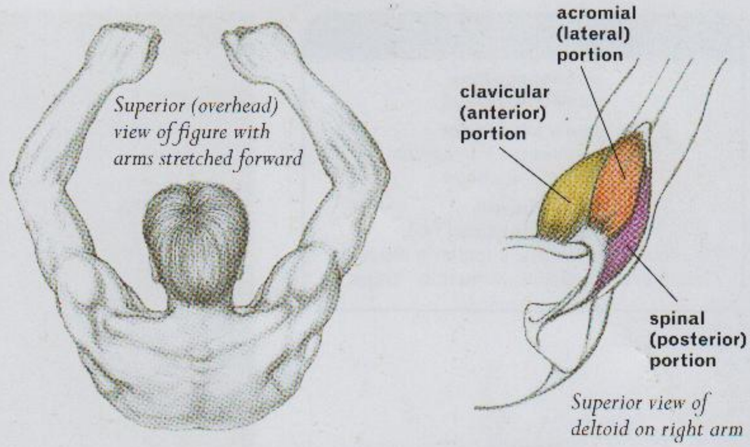
When the arms are lifted upward, there is a collision of forms at the shoulder where the deltoid and trapezius muscles share the same bony attachments (the clavicle and the acromion and spine of the scapula). Because of the great amount of tension in this area when the arms are lifted upward, skin creases usually occur at the shoulder between the trapezius and deltoid muscles. The deltoid's three portions are sometimes visible on the surface form at this junction.



Insertion is behind the cylinder of the abducted arm when the palm is facing forward.

Insertion is more toward the front of the cylinder of the abducted arm when the palm is facing backward.

DELTOID—INSERTION ON ROTATING UPPER ARM

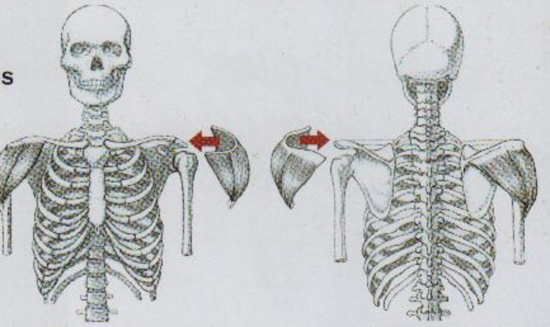


Superior (overhead) view of figure with arms stretched forward

Superior view of deltoid on right arm

THE THREE PORTIONS OF THE DELTOID

DELTOIDS—SIMILAR TO SHOULDER PADS

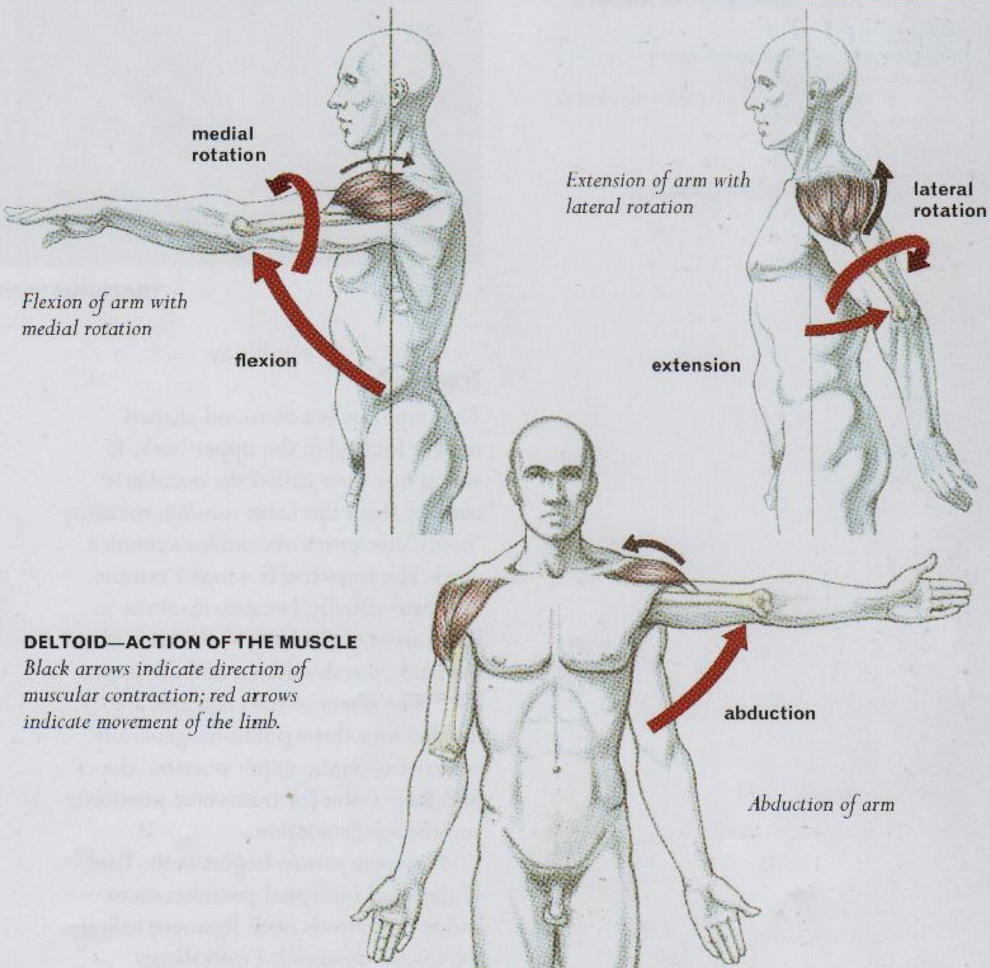


Anterior view *Posterior view*

On the front of the torso, a slight plane change occurs between the borders of the deltoid and the chest muscle (pectoralis major). In some views, a small triangular depression called the *infra-clavicular fossa* occurs below the clavicles between these two borders.

ACTION OF THE MUSCLE

Along with other muscles, the deltoid is used in lifting movements and is active in the swinging of the arms during walking. The three portions of the deltoid contribute unequally to different actions. Although all three portions assist in the action of raising the arm horizontally (abduction), it is mainly the contraction of the acromial, or middle, portion that is responsible for the overall movement. The action of raising the arm out in front of the body (flexion) is mainly implemented by the contraction of the clavicular, or anterior, portion, which also assists in the medial rotation of the humerus. The spinal, or posterior, portion of the deltoid strongly contributes to the action of moving the arm back behind the torso (extension). (A slight lateral rotation of the humerus also occurs in this movement.)



Flexion of arm with medial rotation

Extension of arm with lateral rotation

Abduction of arm

DELTOID—ACTION OF THE MUSCLE

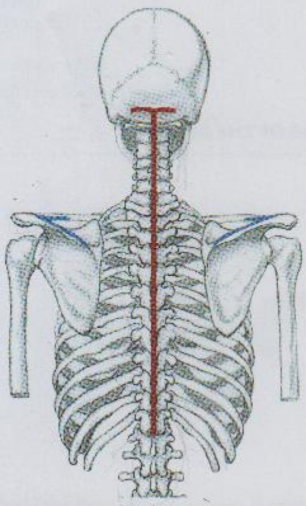
Black arrows indicate direction of muscular contraction; red arrows indicate movement of the limb.

Trapezius

PRONOUNCIATION
traa-PEA-zee-us

ORIGIN OF THE TERM
Greek *trapezion* = irregular four-sided shape

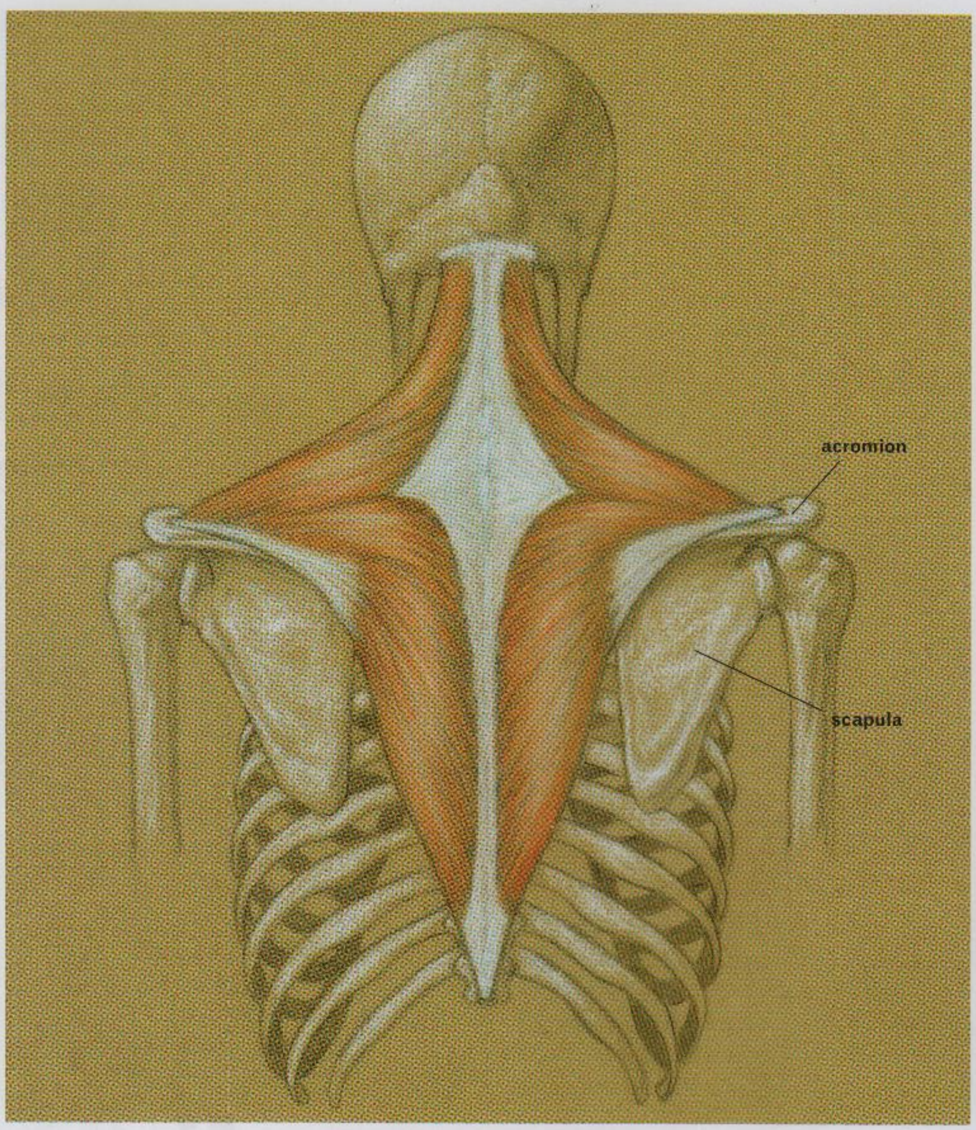
SYNONYMS
musculus trapezius (TA), musculus cucullaris, cucullaris muscle, cucullary muscle, cowl muscle, "traps"



TRAPEZIUS—MUSCLE ATTACHMENTS

ORIGIN
- base of cranium (occipital protuberance)
- fibrous band of nuchal ligament
- spinous processes of seventh cervical vertebra and all twelve thoracic vertebrae

INSERTION
- clavicle (lateral third)
- acromion of spine of scapula (inner border)
- spine of scapula



TRAPEZIUS (POSTERIOR VIEW)

Trapezius

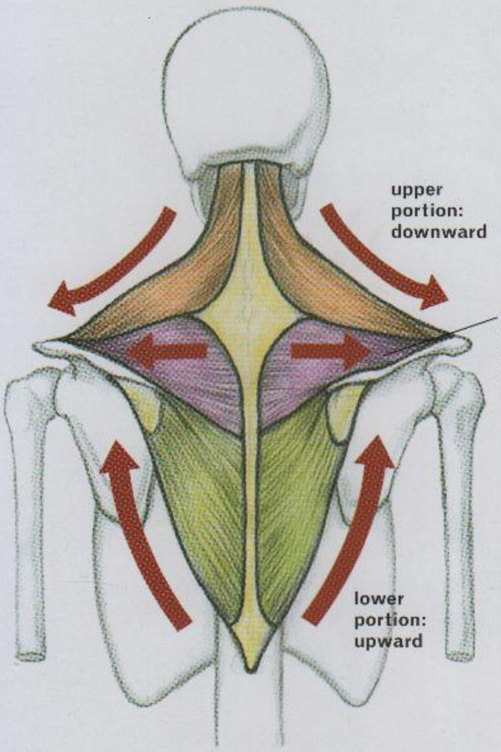
The trapezius is a diamond-shaped muscle located in the upper back. It was at one time called the cucullaris muscle, from the Latin *cucullus,* meaning "hood," because it resembles a monk's cowl. The trapezius is a major muscle to locate visually, because it serves three areas of the body—the back of the neck, the shoulders, and the upper back. The fibers of the trapezius are divided into three portions, generally referred to as the upper portion, the middle portion (or transverse portion), and the lower portion.

The *upper portion* begins at the base of the skull (occipital protuberance) and at the fibrous neck ligament called the nuchal ligament. From there, muscular fibers descend obliquely and insert into the outer (lateral) third of the clavicle.

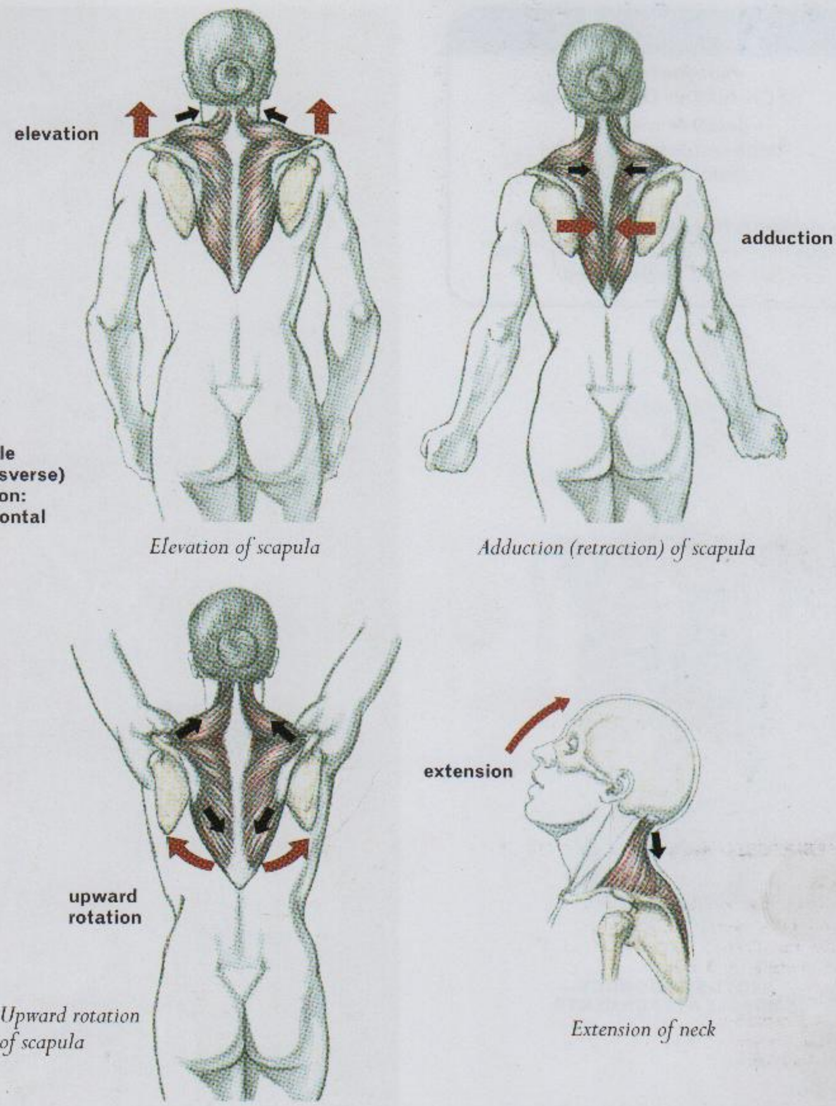
The *middle portion* (or *transverse portion*) begins at locations along the spinous processes of the vertebrae, from the seventh cervical vertebra down to the third thoracic vertebra; from there, the fibers travel more or less horizontally across the back to insert into the acromion and the spine of the scapula. The upper and middle portions contribute importantly to the characteristic mass of the shoulder region.

The *lower portion* of the trapezius begins along the spinous processes of the vertebrae, from the third thoracic vertebra to the twelfth thoracic vertebra; from these locations, the muscular fibers ascend obliquely to insert into the spine of the scapula.

The trapezius changes shape depending on the positions of the arms and scapula bones.



TRAPEZIUS—FIBER DIRECTIONS



Elevation of scapula

Adduction (retraction) of scapula

Upward rotation of scapula

Extension of neck

TRAPEZIUS—ACTION OF THE MUSCLE

Black arrows indicate direction of muscular contraction; red arrows indicate movement of scapula or neck.

ACTION OF THE MUSCLE

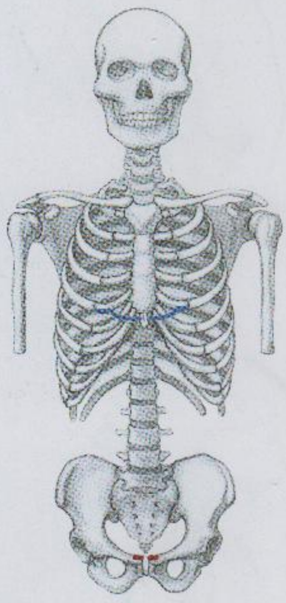
The main function of the trapezius muscle is to move the scapula bones. Each of the three portions of the trapezius contributes to a specific action. In the action of adduction, the middle fibers contract, causing the forms to thicken and compress. This movement, sometimes called squaring the shoulders, is characteristic of the military position of "attention." In the action of upward rotation, the fibers of the upper portion of the trapezius appear to thicken in the shoulder region while the fibers of the lower portion stretch out as the scapula pivots away form the vertebral column. Skin creases showing tension appear in the shoulder region as the trapezius muscle presses against the deltoid. In the action of shrugging the shoulders (elevation) the contracting fibers of the upper trapezius lift the scapula bones upward. When the lower portion of the muscle returns the scapula from an elevated position, this action is called depression of the scapula. The trapezius also helps in the action of tilting the head backward (extension of the neck). The scapula bones remain stationary in this movement, stabilized, in part, by the fibers of the middle portion of the trapezius.

Rectus Abdominis

PRONOUNCIATION
RECK-tuss ab-DOM-ih-niss

ORIGIN OF THE TERM
Latin *rectus* = straight + *abdomen* = belly

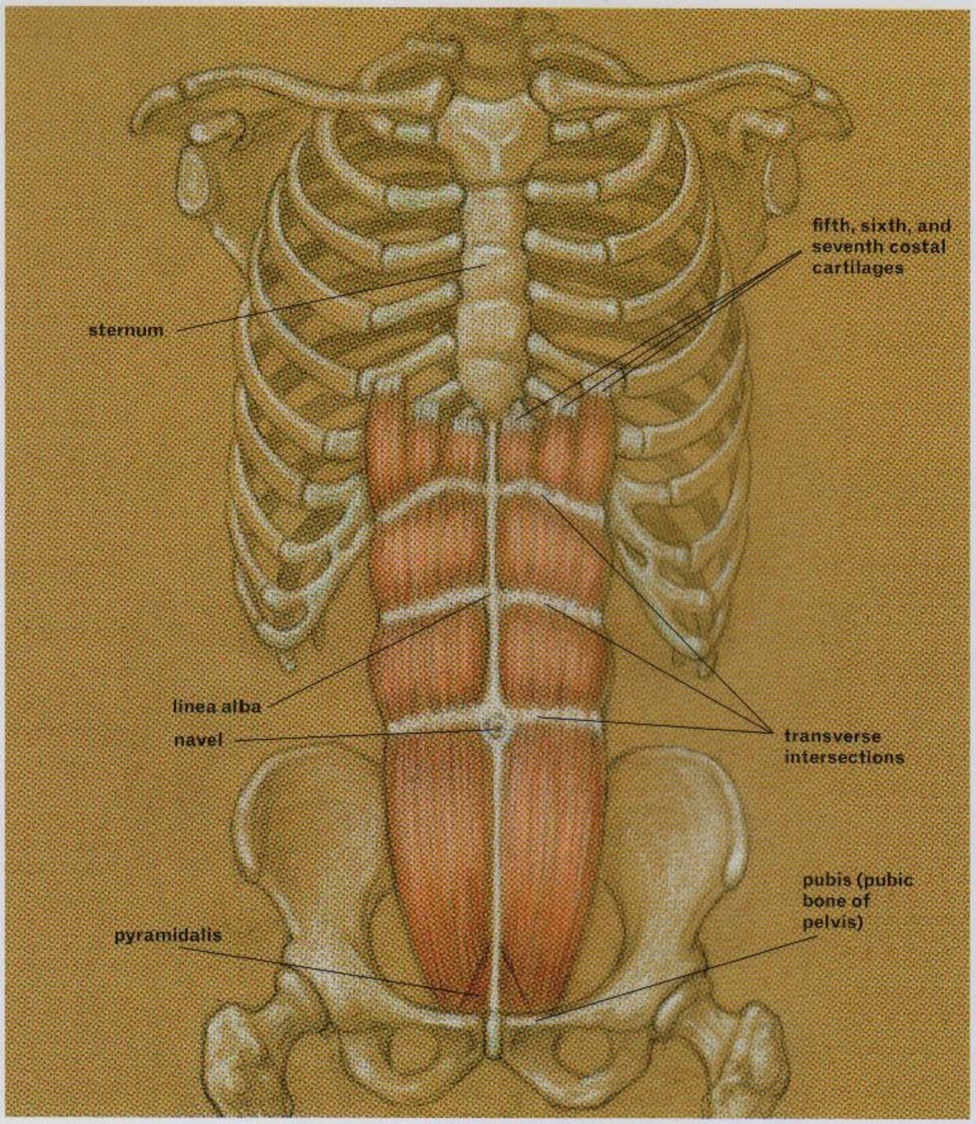
SYNONYMS
musculus rectus abdominis (TA), rectus muscle of abdomen, belly, "abs," "six-pack," "washboard"



RECTUS ABDOMINIS—MUSCLE ATTACHMENTS

ORIGIN
- pubic bone of pelvis

INSERTION
- costal cartilages of fifth, sixth and seventh ribs
- xiphoid process of sternum



RECTUS ABDOMINIS (ANTERIOR VIEW)

Rectus Abdominis

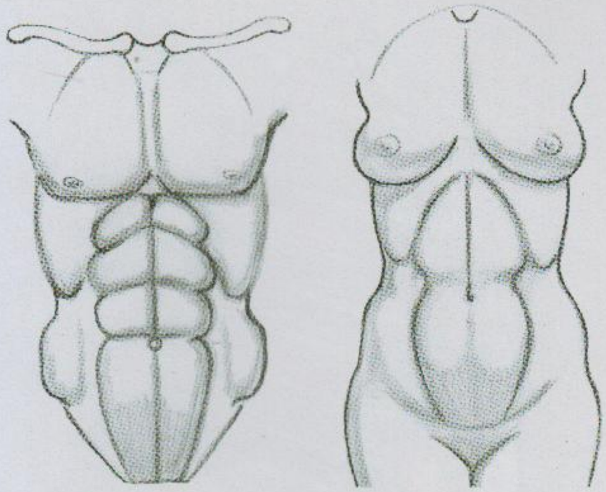
The rectus abdominis is a powerful muscle comprising two elongated muscular bands separated by a vertical fibrous line in the center of the abdomen, called the *linea alba* (Latin, "white line"). The muscle begins on the pubic bone, and the fibers travel vertically upward to attach on the fifth, sixth, and seventh costal cartilage of the ribs as well as on the xiphoid process of the sternum.

THE "SIX-PACK"

Three fibrous lines cut through the rectus abdominis horizontally. These lines, called *transverse intersections* (synonyms: *transverse lines, tendinous intersections*), appear to divide the whole muscle into eight separate segments, four on each side of the linea alba. It can be helpful to know the basic placements of these divisions when observing and drawing the abdomen:

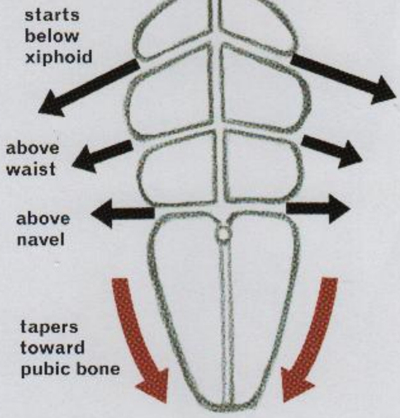
1. The upper transverse line is situated below the xiphoid process and drops diagonally toward the outside borders of the muscle.
2. The middle transverse line is located above the waist and drops at slight angle toward the outside borders.
3. The lower transverse line, at the level of the navel or slightly above, is more horizontal. It can usually be easily seen on trim, muscular bodies.

These muscular divisions vary on different people. On some athletic people, the divisions are symmetrically placed on the abdomen, producing six evenly shaped bulges above the navel (with the belly form below the navel)—an arrangement that is commonly referred as the "six-pack." But even among people whose muscles are somewhat developed, not everyone has classic "six-pack" forms of

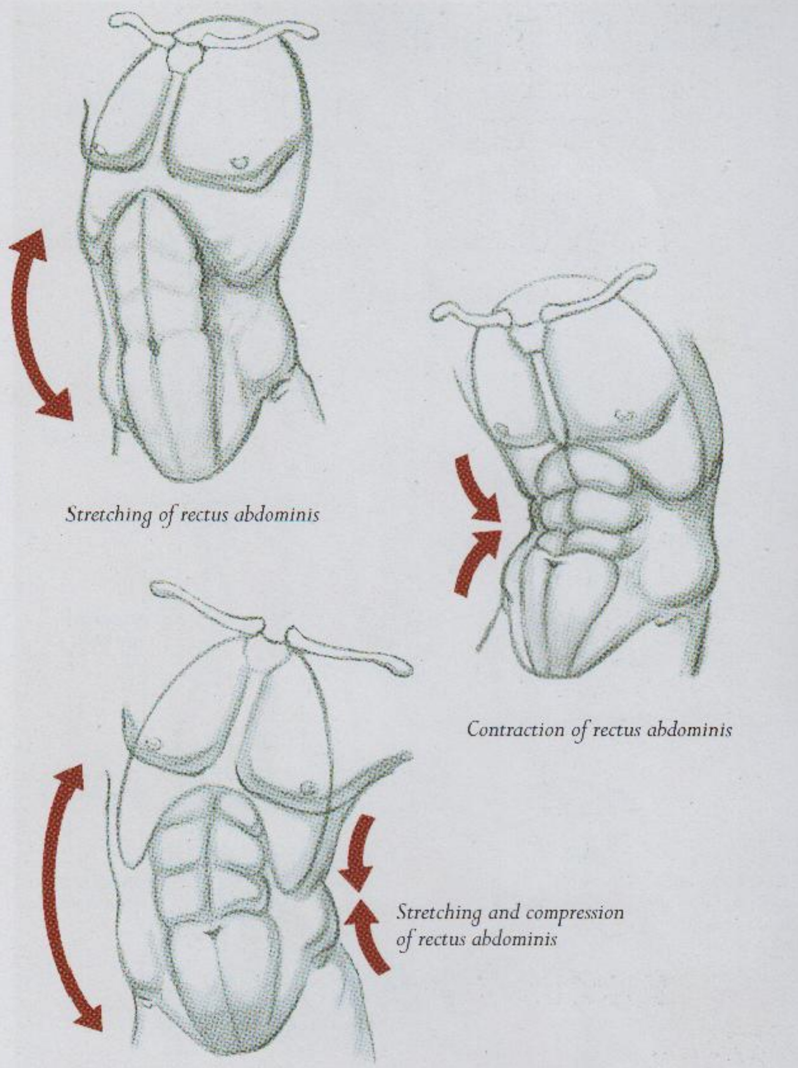


Male abdomen—classic "six-pack"

Female abdomen—"violin" shape



RECTUS ABDOMINIS—CHARACTERISTICS



Stretching of rectus abdominis

Contraction of rectus abdominis

Stretching and compression of rectus abdominis

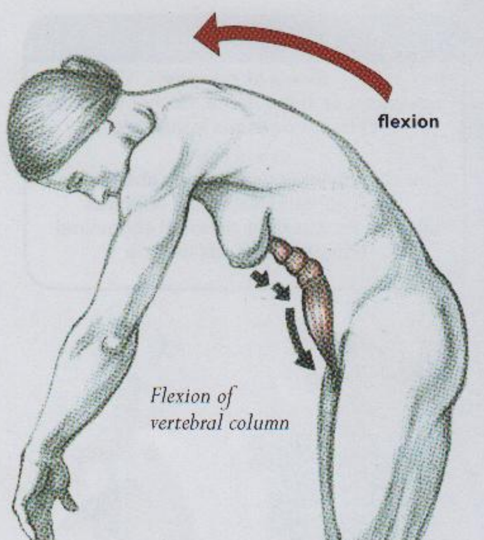
RECTUS ABDOMINIS—ALTERATION OF SHAPE IN DIFFERENT MOVEMENTS

the rectus abdominis. The divisions may appear asymmetrical, producing a zigzag pattern. On people who are mildly to generously proportioned in weight, the rectus abdominis muscle is concealed because of the layering of fatty tissue, which can vary immensely depending on the individual. And occasionally the abdomen region has a "violin" shape, although this is more noticeable in women.

No matter what forms the rectus abdominis has, however, it is essential to observe the overall shape of the abdomen and to identify certain surface landmarks, such as the central axis (linea alba), the navel, the outer edges of the muscle and any muscular bulges in the belly area. Remember that the outer border of the rectus abdominis muscle and the thoracic arch of the ribcage define the general shape of the abdomen.

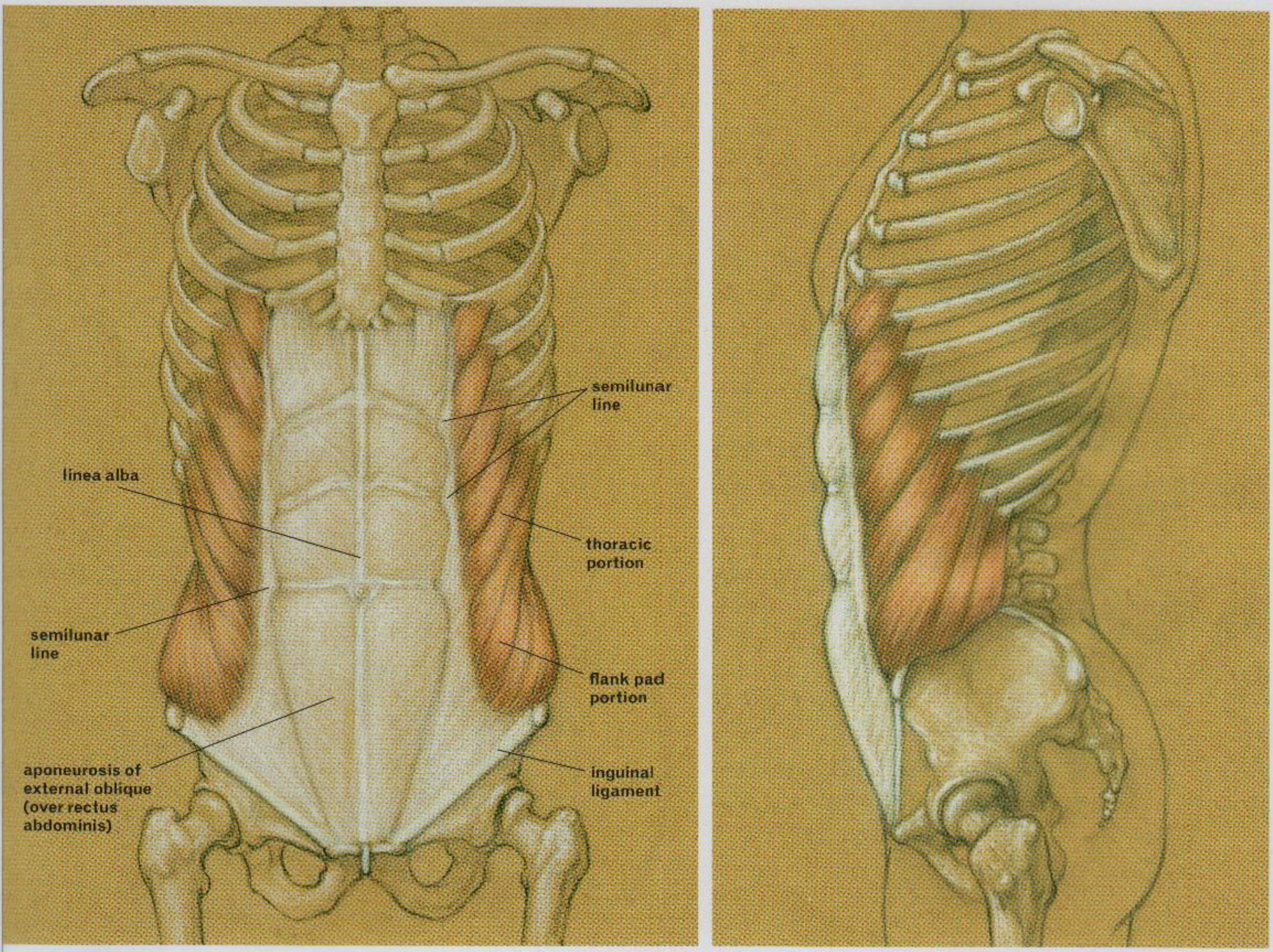
ACTION OF THE MUSCLE

The main action of the rectus abdominis (assisted by the oblique muscles) is to bend the torso forward at the waist in the movement known as the flexion of the vertebral column. It also helps raise the body from a supine position to a sitting-upright position. When the abdominal area is compressed, the rectus abdominis appears to collapse in an accordion-like effect that causes bulges or rolls near the waist. This sort of pose gives you a great opportunity to compare the dynamics of the compressed form of the abdomen to the stretched form of the back. In other action poses, observe the abdominal region to see whether there is any compressing or stretching.



RECTUS ABDOMINIS—ACTION OF THE MUSCLE

Black arrows indicate direction of muscular contraction; red arrows indicate movement of the vertebral column.



EXTERNAL OBLIQUE
Left: Anterior view. Right: Lateral view (left side).

External Oblique

ORIGIN OF THE TERM
externus = on the outside, farther from the center + *obliquus* = slanting

SYNONYMS
musculus obliquus externus abdominis (TA), obliquus externus, obliquus abdominis externus, external abdominal oblique, flank pad muscle

External Oblique

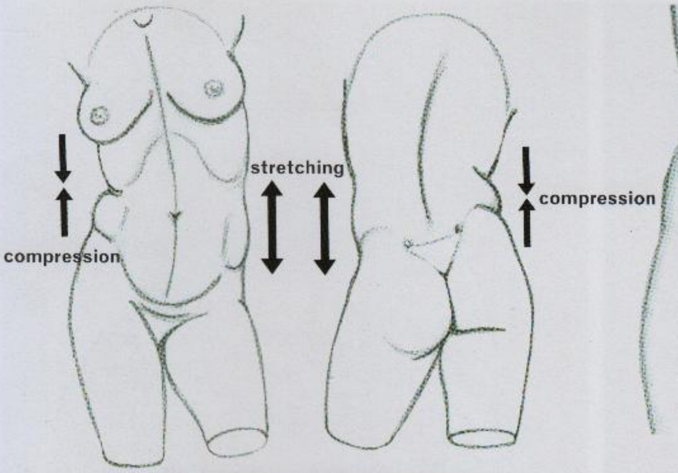
The external oblique muscle covers the front and side (anterior and lateral) of the abdomen and is half muscular and half aponeurotic. It begins with eight fleshy digitations (fingerlike structures) that attach on the exterior surfaces of the lower eight ribs (ribs 5 through 12). The upper four digitations, which interweave with the fibers of the serratus anterior muscle, are referred to as the *thoracic portion* of the external oblique because these strips of muscle attach close to the thorax (ribcage). In muscular figures, the thoracic portion can be seen as a series of slanting muscular strips when the external oblique muscle is tensed.

The lower four digitations of the external oblique are usually referred to as the *flank pad portion* because this area of the muscle can be thick and bulbous in shape. The flank pad portion is considered a principal surface landmark because it is a transitional form between the lower portion of the ribcage and the top ridge of the pelvis (iliac crest), where the muscle inserts. The waist is usually located at the upper section of the flank pad portion. Besides the iliac crest, the fibers of the external oblique also insert into the tendinous fibers of the abdominal fascia, called the *aponeurosis of the external oblique*. The aponeurosis pulls across the abdomen, covering the rectus abdominis

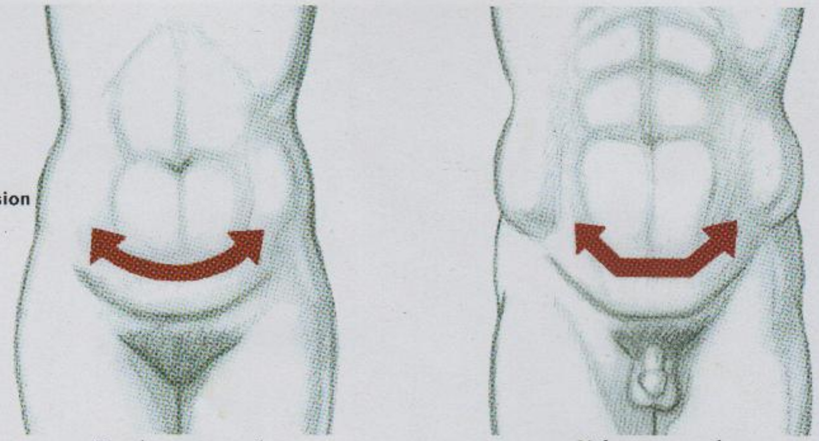
EXTERNAL OBLIQUE—MUSCLE ATTACHMENTS

ORIGIN
- outer surfaces of lower eight ribs (ribs 5 through 12)

INSERTION
- iliac crest of pelvis (front half)
- inguinal ligament
- aponeurosis of external oblique (which inserts into linea alba)



FLANK PADS OF EXTERNAL OBLIQUE— STRETCHING AND COMPRESSION



Female: more curved

Male: more angular

INGUINAL LIGAMENT (FOLD OF THE GROIN)

muscle, and then inserts into the linea alba—the vertical tendinous line that runs from the xiphoid process of the sternum to the pubic bone. The aponeurosis is so thin that it is possible to see the bulging forms of the rectus abdominis muscle beneath.

The *semilunar line* is a small furrow between the inside border of the external oblique and the outside border of the rectus abdominis. Right above the inguinal ligament and near the ASIS of the pelvis is a flattened, triangularly shaped area in the aponeurosis.

STRETCHING AND COMPRESSION OF THE FLANK PADS

When observing the torso, check the position of the pelvis, because this will influence the forms of the flank pads. If the pelvis is tilting, the flank pad on one side will stretch as the flank pad on the other side compresses. Drawing the stretching and compression of these forms will help show the action of the pelvis area.

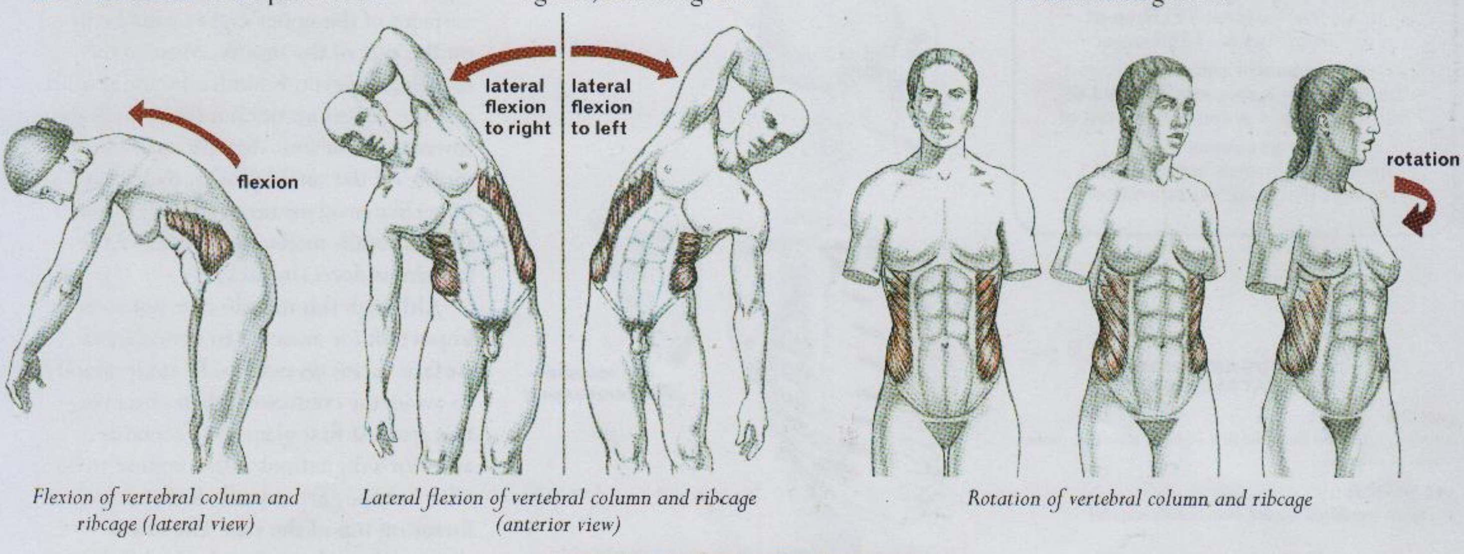
INGUINAL LIGAMENT— CHARACTERISTICS

The *inguinal ligament* (formerly called *Poupart's ligament*) is not a separate form but rather a thicker strip on the lower border of the aponeurosis of the external oblique. This "fold of the groin" extends from the bony protrusions of the hips (the ASIS protrusions) and anchors into the pubic bone near the midline. This ligament helps create a subtle curved or angular crease on the skin surface of the lower abdomen area. Ancient Greek sculptors and Renaissance and Baroque artists emphasized this ligament curvature, along with the flank pads, as prominent surface landmarks indicating movement of the forms between the ribcage and pelvis. The inguinal ligament also serves as a transition between the pelvis and legs because its lower border indicates the bottom edge of the abdomen. On female figures, the fold of the groin is more curved; on male figures, more angular.

ACTION OF THE MUSCLE

The external oblique muscles participate in many movements. They assist the rectus abdominis in the flexion of the vertebral column, which bends the torso at the waist toward the front. The muscles also assist in lateral flexion, which bends the torso sideways. Observe changes of the flank-pad shapes as the pelvis tilts: One flank pad will become more compressed as the other stretches out.

The rotation of the torso—a swiveling movement of the torso that occurs while the feet remain in the same position—is made possible by the external oblique with the assistance of the other abdominal muscles. Look for any compression and stretching of the external obliques in this movement, as well. And when the torso is in a spiraling pose, observe the "pull of action" from the pit of the neck, through the sternum and navel, down to the pubic bone. This is the key to capturing the essential movement of the twisting torso.

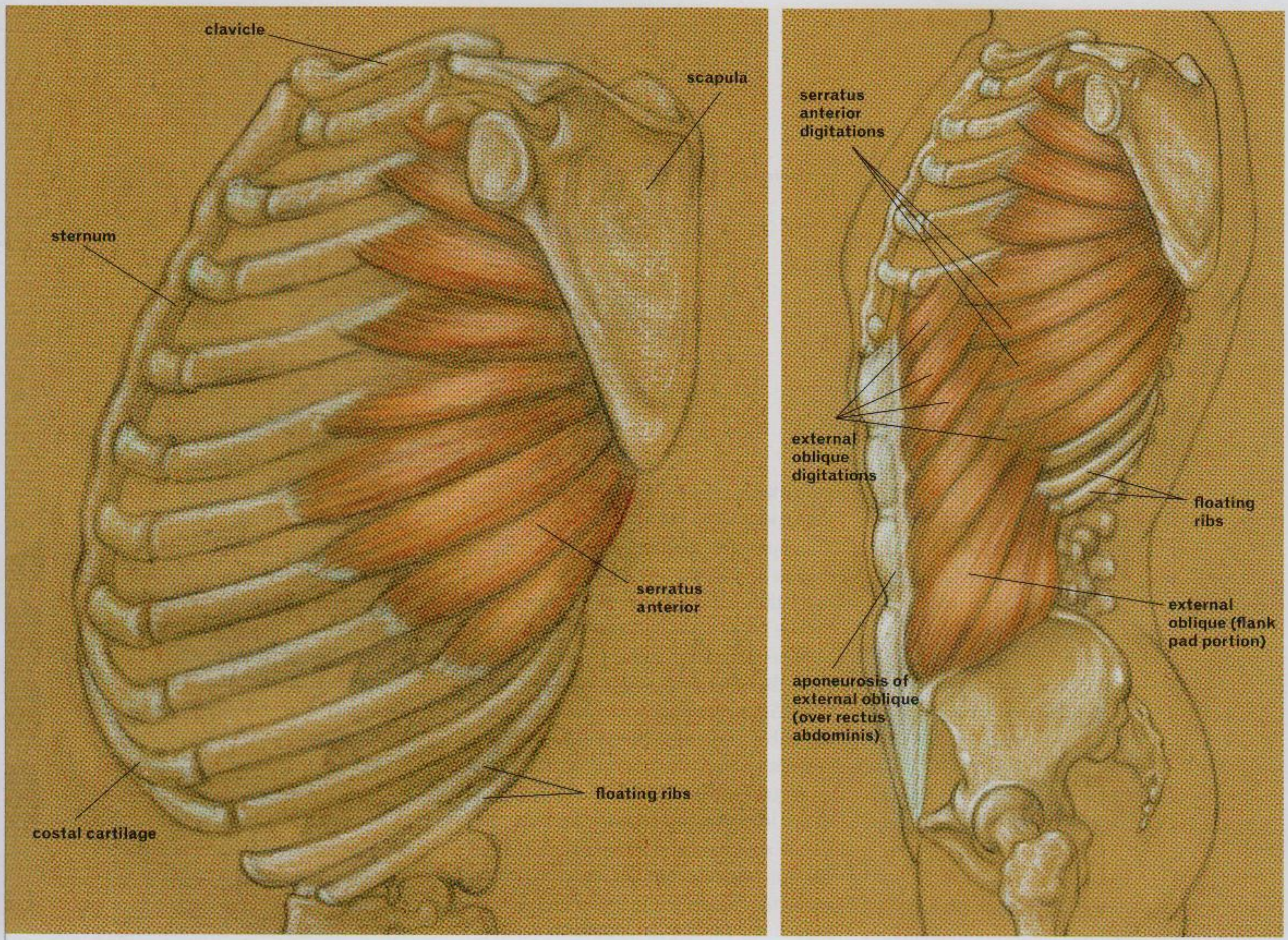


Flexion of vertebral column and ribcage (lateral view)

Lateral flexion of vertebral column and ribcage (anterior view)

Rotation of vertebral column and ribcage

EXTERNAL OBLIQUE—ACTION OF MUSCLE



SERRATUS ANTERIOR

Left: Lateral view of ribcage with serratus anterior. Right: Lateral view of serratus anterior and external oblique.

Serratus Anterior

PRONOUNCIATION

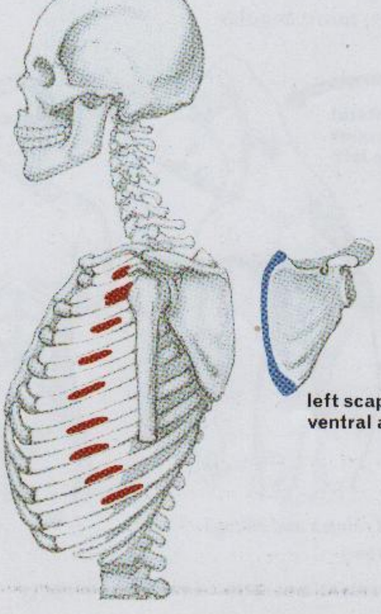
sir-AA-tuss an-TEER-ee-or
or sir-RAT-tuss an-TEER-ee-or
or sir-RAH-tuss an-TEER-ee-or
or sir-RAY-tuss an-TEER-ee-or
or SIR-ah-tus an-TEER-ee-or

ORIGIN OF THE TERM

Latin *serra* = a saw, saw-toothed or serrated edge + *anterior* = in front of

SYNONYMS

musculus serratus anterior (TA), serratus magnus, "boxer's muscle"



SERRATUS ANTERIOR—MUSCLE ATTACHMENTS

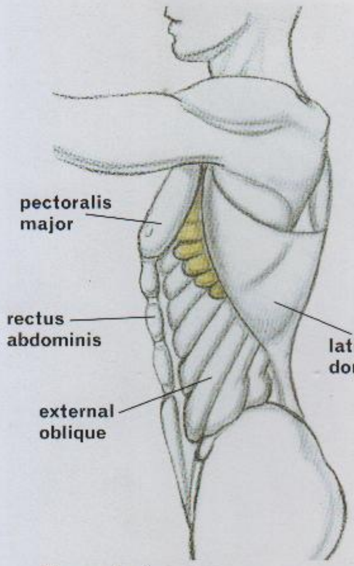
ORIGIN
- fleshy digitations from the first eight or nine ribs (outer side of ribcage)

INSERTION
- scapula (vertebral border, underneath scapula)

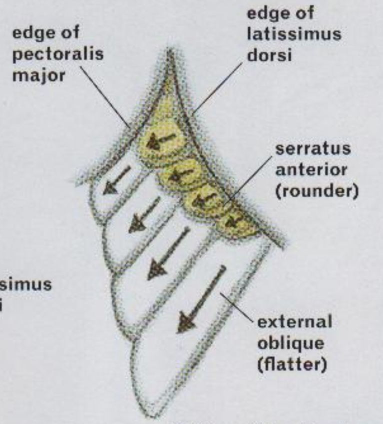
Serratus Anterior

The serratus anterior is a fan-shaped muscle consisting of eight or nine fleshy digitations that begin from the outer surfaces of the upper eight or nine ribs on the side of the thorax. Most of this muscle, however, is hidden by the scapula and the latissimus dorsi muscle; only the lower three or four digitations are ever visible on the surface form, their small, fingerlike protrusions nestled between the pectoralis major (in front) and the latissimus dorsi (in back).

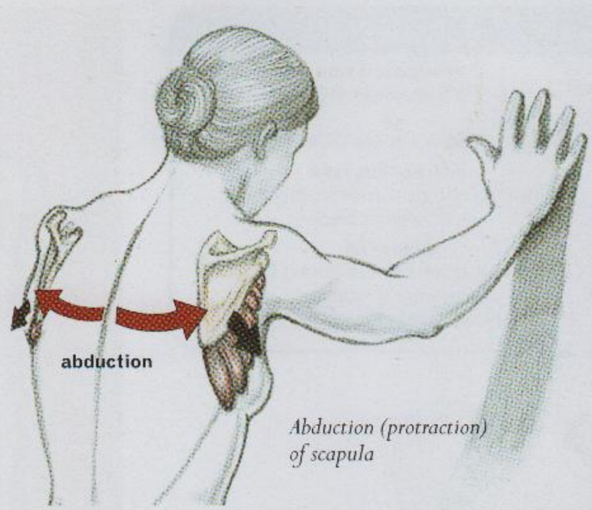
Although this muscle may not seem important for an artist to consider, its surface forms do need to be understood to avoid any confusion when observing this area. At first glance the serratus anterior's digitations might appear to be ribs, but they are actually fleshy muscular forms on top of the ribs. The lower three or four digitations look as if they



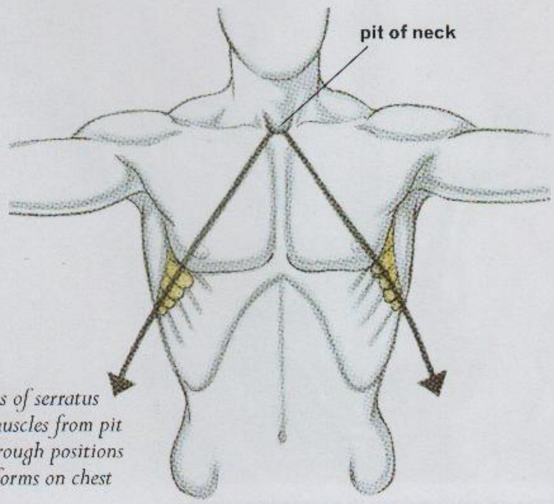
Placement of serratus anterior on surface form



Different fiber directions of serratus anterior and external oblique

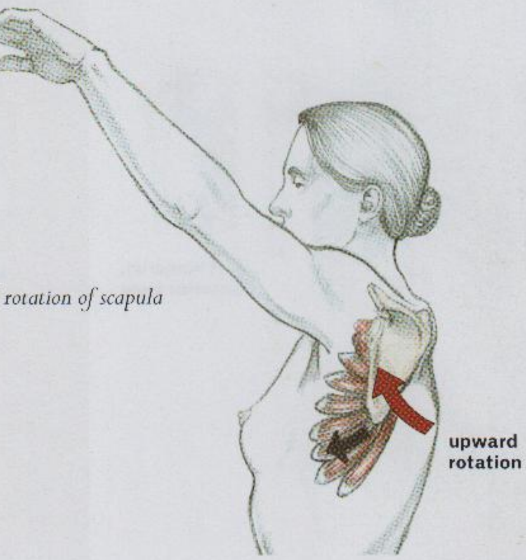


Abduction (protraction) of scapula



Alignments of serratus anterior muscles from pit of neck through positions of nipple forms on chest

SERRATUS ANTERIOR—CHARACTERISTICS



Upward rotation of scapula

SERRATUS ANTERIOR—ACTION OF THE MUSCLE

Black arrows indicate direction of muscular contraction; red arrows indicate movement of the scapula.

interweave with the digitations of the external oblique, causing a "serrated edge" along the serratus anterior's outer border on cadavers and écorché studies.

On the living figure, the small, riblike bulges of the serratus are more noticeable on muscular figures than on thinner figures. It is important to observe the slightly different directions of the serratus anterior's fibers and those of the external oblique. The last three to four digitations of the serratus are rounder and tend almost to follow the alignment of the ribs, while the digitations of the external oblique are flatter and descend more obliquely.

The outer edges of the last three or four digitations of the serratus anterior create a slight curve (between the pectoralis major and the latissimus dorsi) that aligns with the nipple form of the chest. In front views of some figures, this alignment of the tips of the serratus and the nipple form will also align with the pit of the neck.

In profile and back views, a slight bulge sometimes occurs beneath the latissimus dorsi near the bottom tip (inferior angle) of the scapula. This bulge reveals the position of the rest of serratus anterior, which is hidden by the latissimus dorsi.

ACTION OF THE MUSCLE

The main function of the serratus anterior is to move the scapula. When the whole muscle contracts, the serratus moves the entire scapula away from the vertebral column (abduction), causing the trapezius and rhomboid muscles to stretch in that area. When the lower fibers of the serratus contract, the muscle moves the inferior angle (lower corner) of the scapula farther from the vertebral column, causing a rotation of the scapula. This is especially noticeable in poses where the arms are raised over the head.

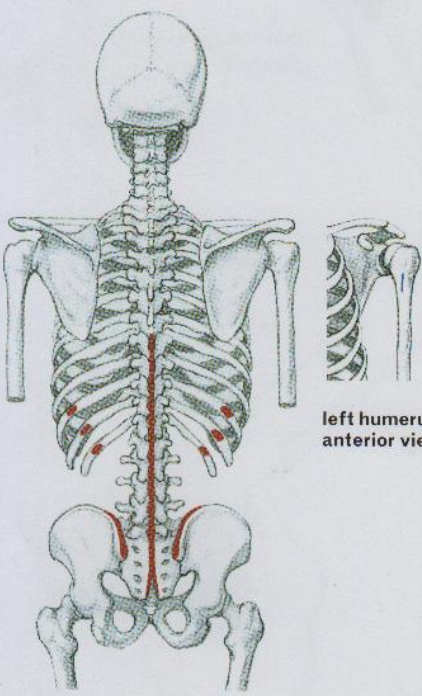
The serratus anterior also assists in movements of reaching, pushing, and punching, which is why it is sometimes referred to as the boxer's muscle. The digitations of the serratus anterior are especially visible when the arms are pushing against some resistance (such as a wall or large object).

Latissimus Dorsi

PRONOUNCIATION
lah-TISS-ih-muss DOR-see
or
lah-TISS-ih-muss DOR-sigh

ORIGIN OF THE TERM
Latin *latissimus* = widest, broadest + *dorsum* = back

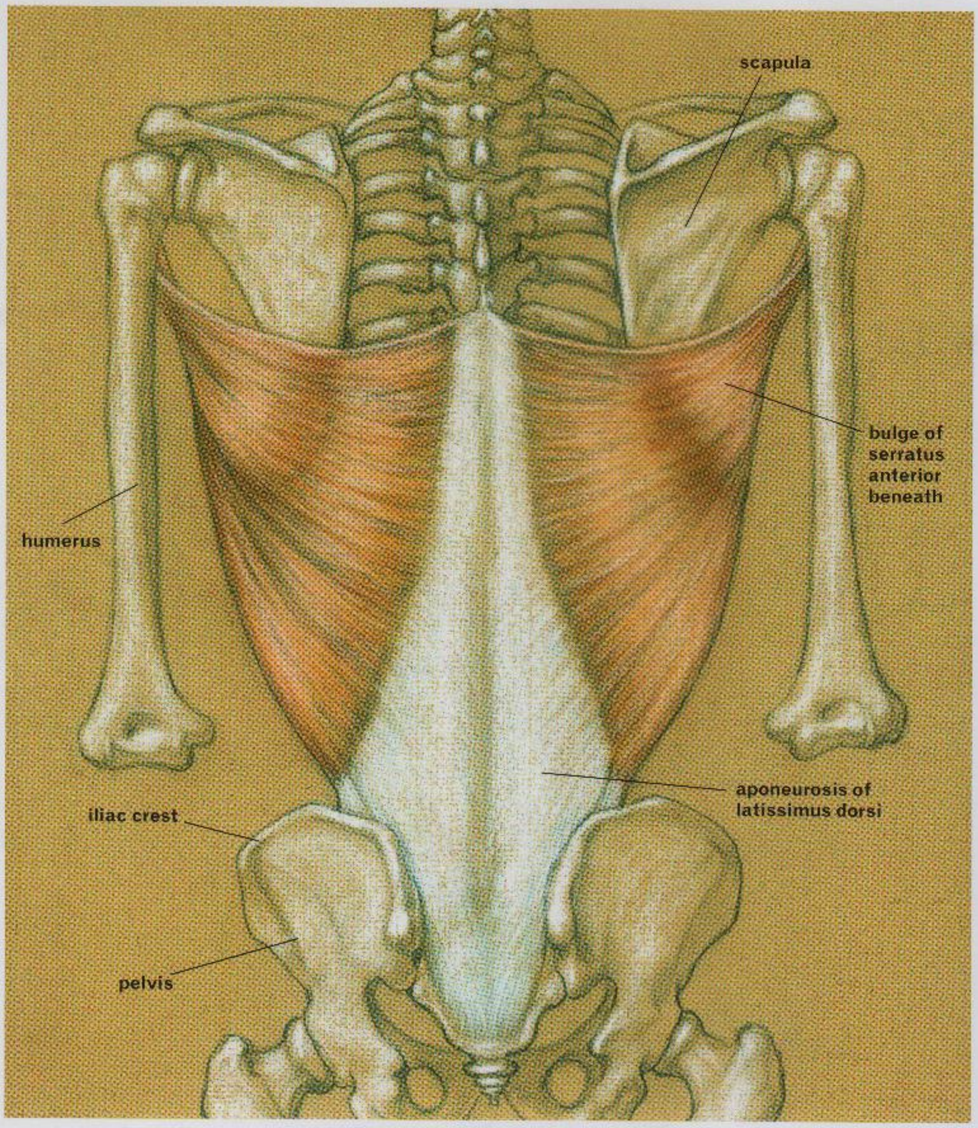
SYNONYMS
musculus latissimus dorsi (TA), "swimmer's muscle," "dress-coat pocket muscle," "lats"



LATISSIMUS DORSI—MUSCLE ATTACHMENTS

ORIGIN
- spinous processes of lower six thoracic vertebrae
- spinous processes of all five lumbar vertebrae
- spinous processes of sacrum
- iliac crest of pelvis (posterior third)
- posterior surface of last three ribs

INSERTION
- humerus (floor of inter-tubercular groove)

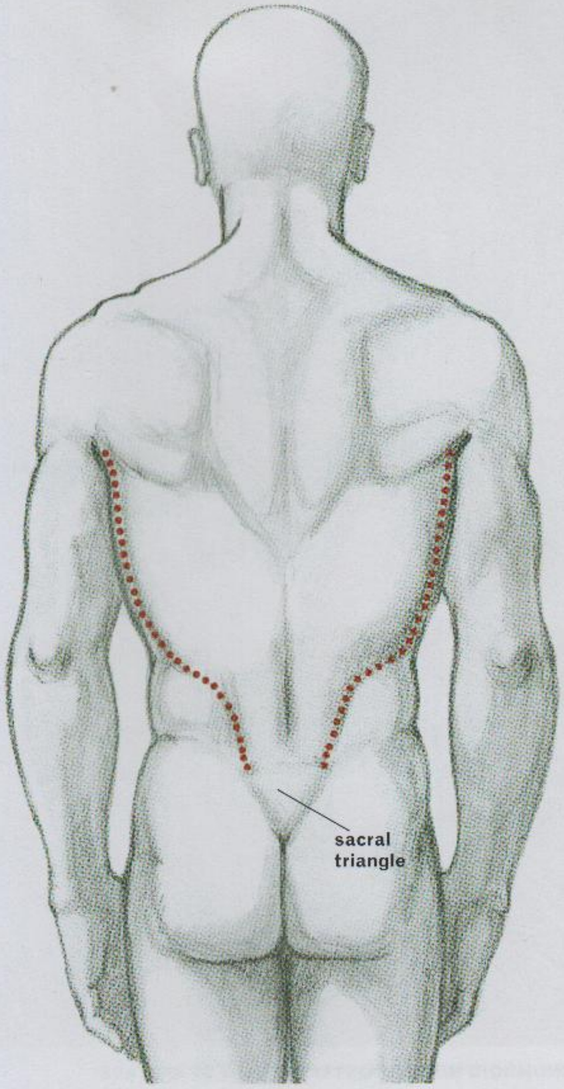


LATISSSIMUS DORSI (POSTERIOR VIEW)

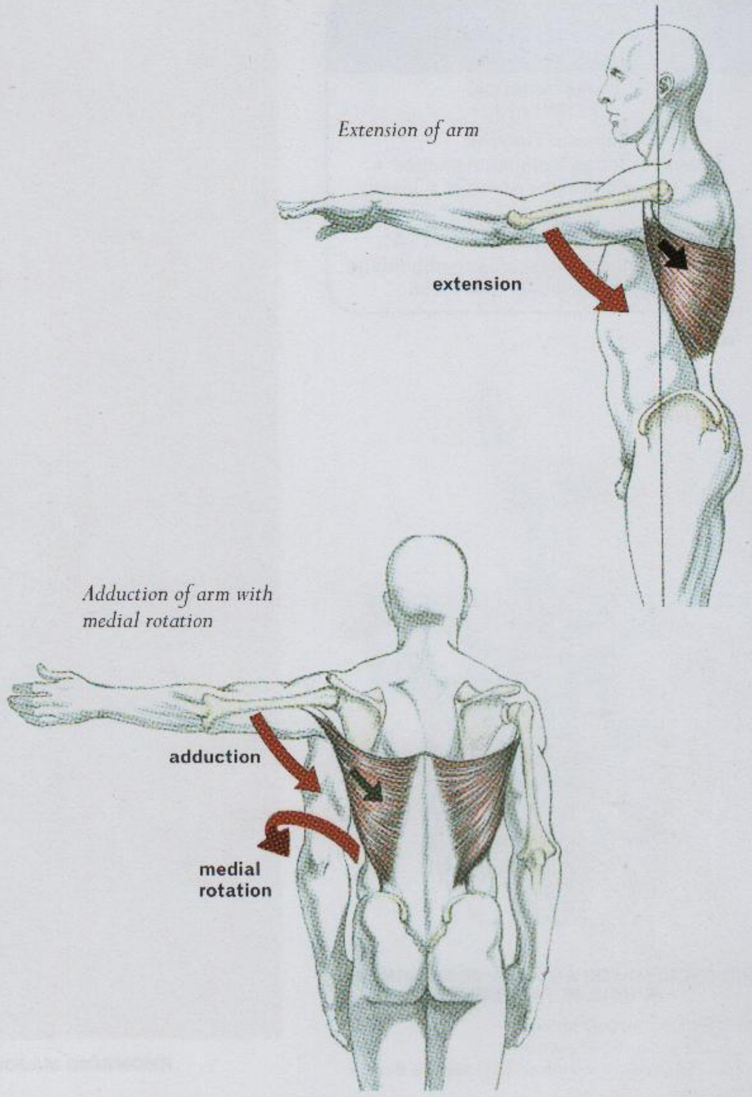
Latissimus Dorsi

The latissimus dorsi is a triangular muscle that occupies a large portion of the back. It begins from the spinous processes of the lower six thoracic vertebrae, the five lumbar vertebrae, and the sacral vertebrae and from the posterior third of the iliac crest of the pelvis; it is joined to these locations by a thin fascia called the *aponeurosis of the latissimus dorsi*. The aponeurosis appears as a large arrowhead shape on cadavers and écorché studies. Because the aponeurosis is so thin, the sacrospinalis muscle, which lies directly underneath the latissimus dorsi, is sometimes visible as two thick, columnar forms on either side of the vertebral column directly above the sacrum in the small of the back.

As the latissimus dorsi's fibers extend from the aponeurosis, the muscle also attaches to the lower three ribs through a series of fleshy digitations, but these cannot be seen on the surface form. The upper border of the latissimus dorsi crosses over the lower corner (inferior angle) of the scapula and assists in holding the shoulder blade close to the ribcage. The muscle then tapers into a tendon that makes a slight twist before it inserts, along with the teres major (lower scapula muscle), into the upper arm bone (humerus). The point of insertion is on the inside of the humerus, on the floor of the inter-tubercular groove. On the surface form, the outside (lateral) border of the latissimus dorsi can usually be detected, especially if the arm is positioned out in front of the torso. It appears as a thick curve ascending toward the armpit region.



LATISSIMUS DORSI—V SHAPE



LATISSIMUS DORSI—ACTION OF THE MUSCLE
Black arrows indicate direction of muscular contraction; red arrows indicate movement of the humerus.

The latissimus dorsi creates the "back wall" (or posterior wall) of the armpit, just as the pectoralis major creates the armpit's front (or anterior) wall. When the arm is raised overhead, the latissimus dorsi can be seen inserting indirectly into the base of the arm in the axilla region, while the teres major inserts slightly higher up.

The latissimus is a dynamic muscle; if well developed it can give the overall form of the back a distinctive V shape. On muscular figures, the arms appear to flair slightly away from the body when they hang at the sides of the torso. This is usually because the muscular fibers of the latissimus dorsi are very thick near the point of attachment, preventing the arms from resting too close to the torso.

ACTION OF THE MUSCLE

The large V-shaped muscle of the back helps move the arms to different positions. It assists in the movements pulling, climbing, hammering, rowing, and chin-ups, as well as in the movements of the arms during swimming.

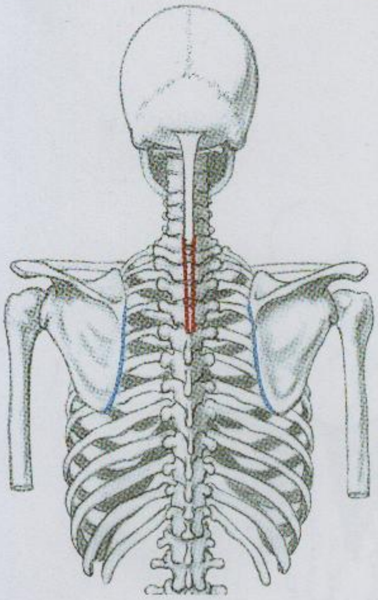
The latissimus dorsi adducts the arm, pulling a vertically or horizontally positioned arm back to the side of the torso. It also assists in the extension of the arm, which is the action of returning a flexed arm positioned in front of the torso back to the side of the torso. (If the arm is moved farther backward, the action is called hyperextension.) It also plays a role in the medial rotation, which rotates the arm inward.

Rhomboid Major and Rhomboid Minor

PRONOUNCIATION
ROM-boyd

ORIGIN OF THE TERM
Greek *rhombus* = diamond shaped + Latin *major* = greater or *minor* = lesser

SYNONYMS
musculus rhomboideus major (TA), greater rhomboid; musculus rhomboideus minor (TA), lesser rhomboid



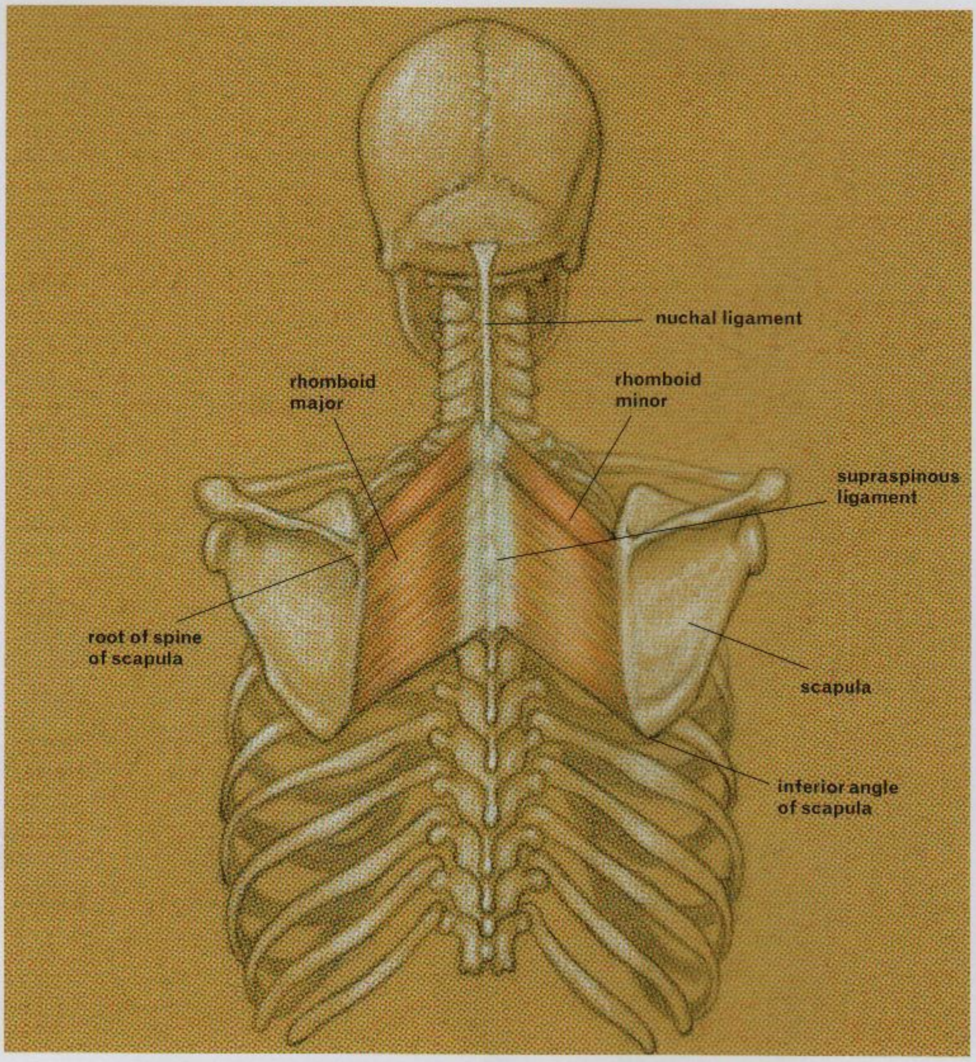
RHOMBOID MAJOR AND RHOMBOID MINOR—MUSCLE ATTACHMENTS

ORIGIN (RHOMBOID MINOR)
- nuchal ligament (lower portion)
- spinous processes of seventh cervical and first thoracic vertebrae

INSERTION (RHOMBOID MINOR)
- scapula (vertebral border, at root of spine of scapula)

ORIGIN (RHOMBOID MAJOR)
- spinous processes of second, third, fourth, and fifth thoracic vertebrae
- supraspinous ligament (on midline of back)

INSERTION (RHOMBOID MAJOR)
- scapula (vertebral border, from root of spine of scapula to inferior angle)



RHOMBOID MAJOR AND RHOMBOID MINOR (POSTERIOR VIEW OF RIBCAGE)

Rhomboid Major and Rhomboid Minor

The rhomboid major and rhomboid minor muscles are situated underneath the superficial muscle of the trapezius but overtop the sacrospinalis, which is deeper. Together, the rhomboid muscles form a pair of parallelograms—one on either side of the vertebral column. Generally, the rhomboids are hard to see in their entirety on the surface form, but in certain poses small parts of the muscles can be detected.

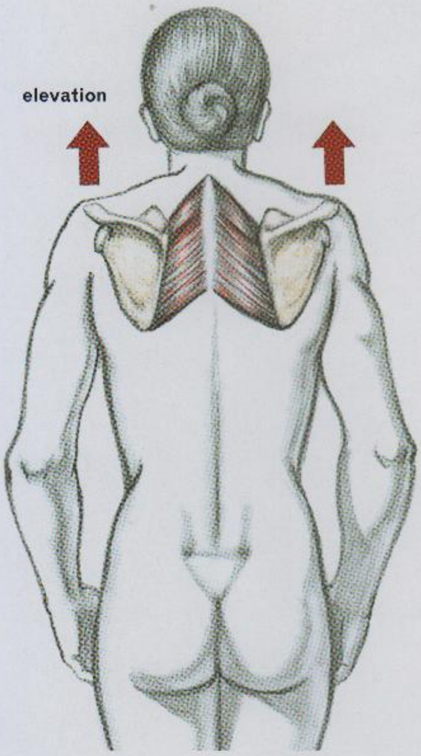
The small, cylindrical rhomboid minor muscle is positioned above the rhomboid major and begins at the lower portion of the nuchal ligament of the neck and the spinous processes of the seventh cervical vertebra and the first thoracic vertebra. The muscle then inserts obliquely into the medial border of the scapula.

The rhomboid major, which is twice as large as its smaller counterpart, begins on the spinous processes of the second through fifth thoracic vertebrae and inserts along the medial border of the scapula.

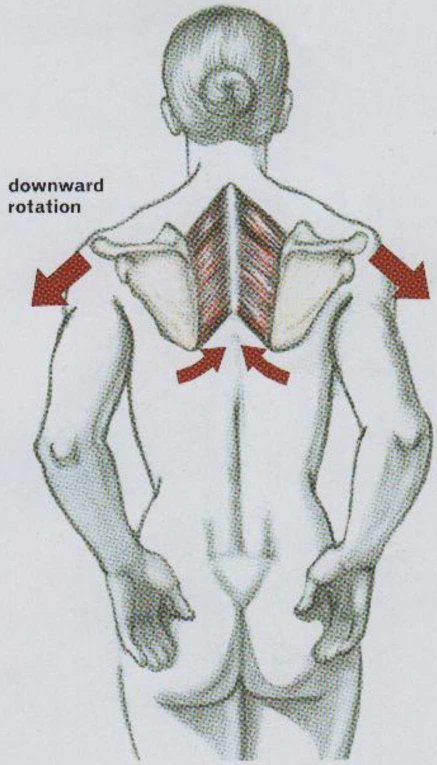
In poses where the scapula is being pulled toward the spinal column but not rotated, an elongated oval shape occurs between the spinal column and the inner borders of the scapula. These two oval shapes (on either side of the spinal column) are caused by the contracted rhomboids under the trapezius. The rhomboids can also be seen in a small triangular space that occurs near the bottom tip and the inner border of the scapula, the top border of the latissimus dorsi, and the outer edge of the trapezius muscle. This triangular shape will appear either as a depression or as a softly bulging shape, depending on the placement of the scapula bones and how toned the muscles are.

ACTION OF THE MUSCLES

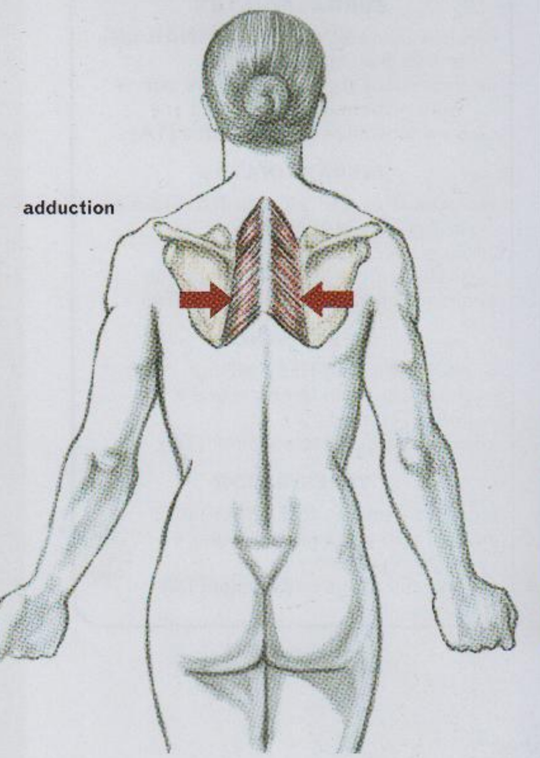
The rhomboid muscles help move the scapula bones to different positions



Elevation of scapula



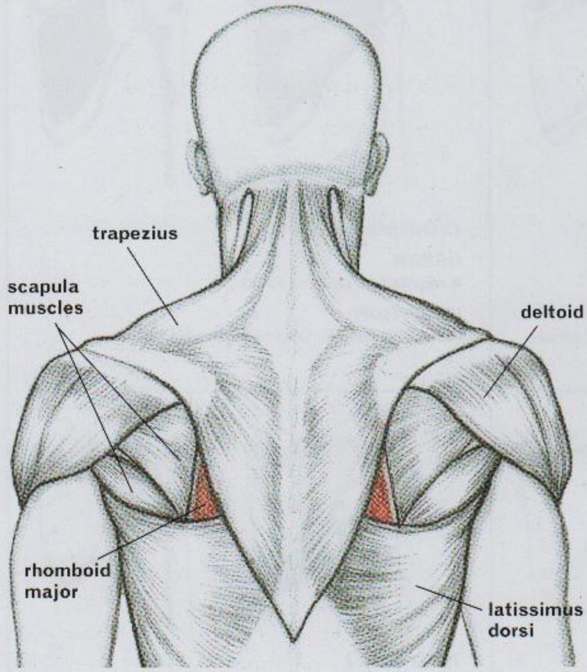
Downward rotation of scapula



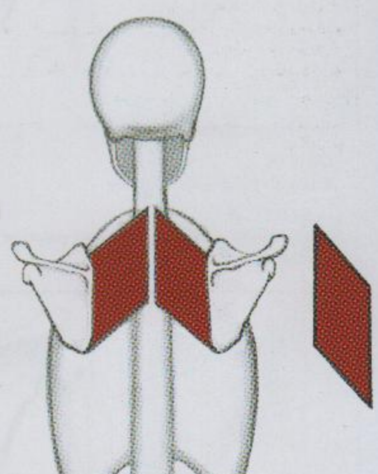
Adduction (retraction) of scapula

RHOMBOID MAJOR AND RHOMBOID MINOR—ACTION OF THE MUSCLES

depending on which other muscles are also contracting at the time. The rhomboids work together to adduct (retract) the scapula toward the vertebral column. With other muscles, they help move the scapula in a downward rotation, with the acromion and glenoid cavity moving downward and the bottom corner of the scapula (inferior angle) moving medially or inward. This type of action occurs when the arms are lowered against resistance, as when someone uses a paddle when canoeing or drives a stake with a sledgehammer. (It can also occur when someone reaches into a back hip pocket.) In this action of downward rotation, the scapula can also elevate and adduct at the same time. In the action of shrugging the shoulders, the rhomboids (along with the upper fibers of the trapezius muscle) help elevate the scapula bones upward. The rhomboids also stabilize the scapula against the thorax.



Rhomboid muscles in relation to other muscles of upper back (posterior view)



Rhomboid major and minor shaped like a parallelogram

RHOMBOID MAJOR AND RHOMBOID MINOR—SHAPE AND PLACEMENT

Muscles of the Scapula

SUPRASPINATUS

PRONOUNCIATION SOO-prah-spih-NAH-tuss *or* soo-prah-spy-NAY-tuss
ORIGIN OF TERM Latin *supra* = above, over + *spina* = thorn, spine
SYNONYM musculus supraspinatus (TA)

INFRASPINATUS

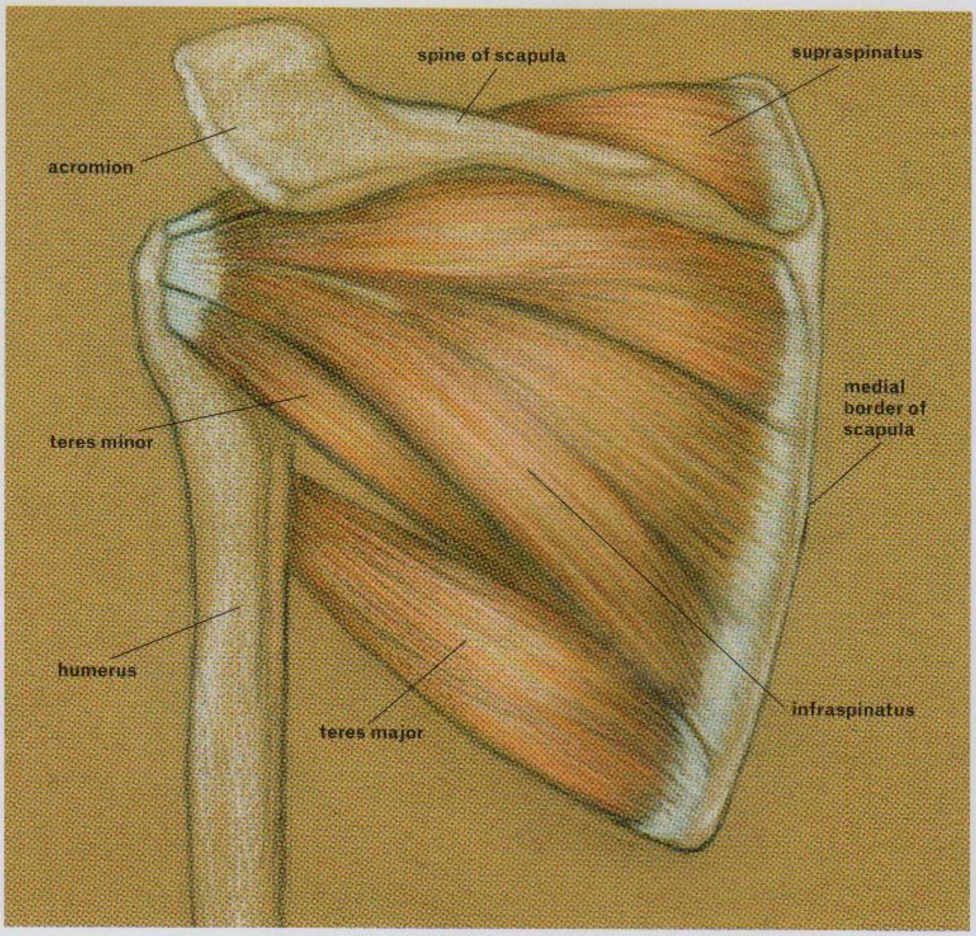
PRONOUNCIATION IN-frah-spih-NAH-tuss *or* in-frah-spy-NAY-tuss
ORIGIN OF TERM Latin *infra* = below, underneath + *spina* = thorn, spine
SYNONYM musculus infraspinatus (TA)

TERES MINOR

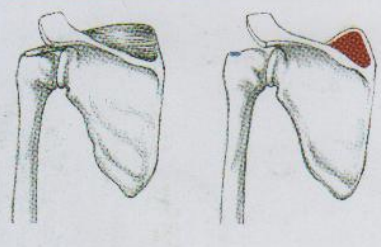
PRONOUNCIATION teh-REEZ MY-nur
ORIGIN OF TERM Latin *terez* = round + *minor* = lesser
SYNONYM musculus teres minor (TA)

TERES MAJOR

PRONOUNCIATION teh-REEZ MAY-jur
ORIGIN OF TERM Latin *terez* = round + *major* = greater
SYNONYM musculus teres major (TA)



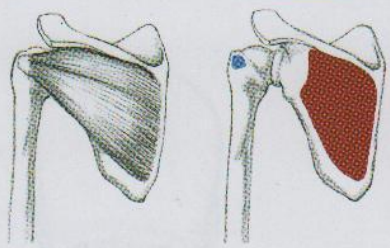
SCAPULA GROUP (POSTERIOR VIEW, LEFT SCAPULA)



Supraspinatus

ORIGIN
- scapula (supraspinous fossa)

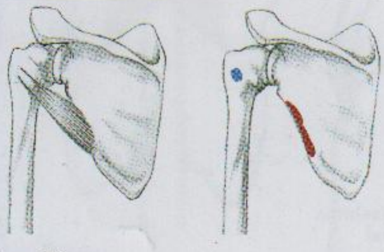
INSERTION
- humerus (superior facet [highest point] of greater tubercle)



Infraspinatus

ORIGIN
- scapula (infraspinous fossa)

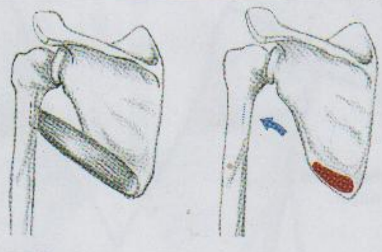
INSERTION
- humerus (middle facet of greater tubercle)



Teres Minor

ORIGIN
- scapula (lateral border, upper two-thirds)

INSERTION
- humerus (lowest facet of greater tubercle)



Teres Major

ORIGIN
- scapula (inferior angle and lower third of lateral border)

INSERTION
- humerus (crest of lesser tubercle)

SCAPULA GROUP—MUSCLE ATTACHMENTS

The Scapula Group

The scapula muscles are a group of muscles that begin on the scapula bone and insert near the head of the humerus. The four muscles of the scapula group are the *supraspinatus,* the *infraspinatus,* the *teres minor,* and the *teres major.* Usually, only the infraspinatus and teres major can be seen on the surface form, but in certain poses the other two may make their presence known.

The scapula group is bordered by the large muscle forms of the trapezius (on the medial border of the scapula group), the latissimus dorsi (on the bottom border of the scapula group), and the deltoid (on the top and lateral border of the scapula group). Artists often find the back muscles of the torso very confusing, but if you have an awareness of the main muscular shapes (trapezius, latissimus dorsi, deltoid) and of the bony landmarks (vertebral column and scapula bones), then you will find it easier to figure out all the smaller bulging forms of the back. If any of the bulging forms occurs on the shoulder blade, then it is most likely one of the scapula muscles.

The first three scapula muscles—the supraspinatus, infraspinatus, and teres minor—are known as *rotator cuff muscles.* (A fourth rotator cuff muscle, called the *subscapularis* [not shown], is attached under the scapula and is not visible on the surface form.) These three muscles help hold the head of the humerus in its socket (the glenoid fossa), as well as assisting in the abduction, adduction, and lateral rotation of the humerus. The greater tubercle of the humerus has three facets (highest, middle portion, lowest point), and each of these muscles inserts into a specific facet. The tendons are not visible on the surface form because the deltoid muscle covers them at their insertions.

SUPRASPINATUS

The supraspinatus muscle nestles into the supraspinous fossa, which is located above the spine of the scapula. It is completely covered by the trapezius muscle and is not apparent on the surface form except when the arm is abducted (pulling away from the torso). When this action occurs, a distinct bulge from the supraspinatus can occasionally be seen above the spine of the scapula, near the medial border.

INFRASPINATUS

The infraspinatus muscle is located below the spine of the scapula and generally occupies most of the scapula fossa. It has a flat, triangular shape except in certain movements when the arm is laterally rotated; then, the infraspinatus can become thick and more rounded in appearance. The deltoid covers the outer portion of the infraspinatus. The infraspinatus is divided into two portions (superior and inferior), and this division can sometimes be detected on the living figure. Usually, however, the whole muscle registers as a singular mass.

TERES MAJOR

The teres major has an elongated cylindrical shape that is easy to locate, especially when the muscle is tense. It is positioned on the lower region of the scapula group and above the latissimus dorsi. These two muscles—the teres major and latissimus dorsi—travel toward the armpit region together, and their shapes are clearly seen on the surface form when the arm is pulled away from the torso. The latissimus dorsi covers a small lower portion of the teres major and then it wraps around it like a sling as it inserts into the humerus.

TERES MINOR

The teres minor is rarely seen on the surface form because its shape tends to blend with that of the infraspinatus.

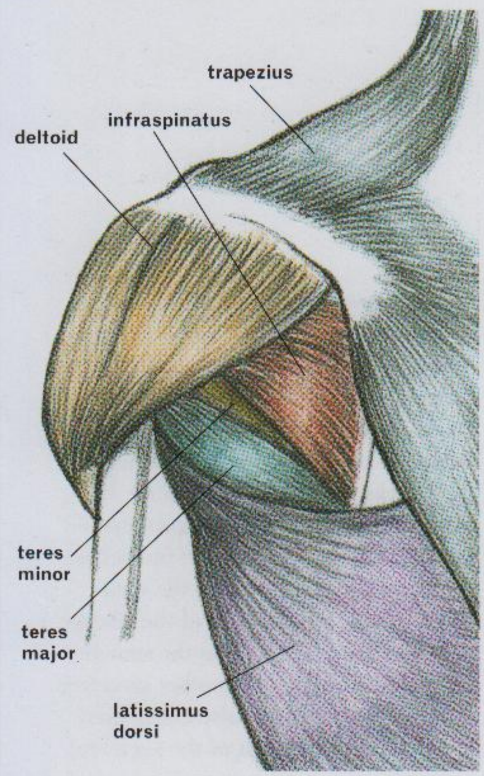
ACTION OF THE MUSCLES

The muscles of the scapula group move the arm into different positions. Each muscle produces a different action or actions, with the exception of the teres minor, which assists in the same movements as the infraspinatus. In addition, all the muscles of the group except the teres major help stabilize the scapula in certain movements.

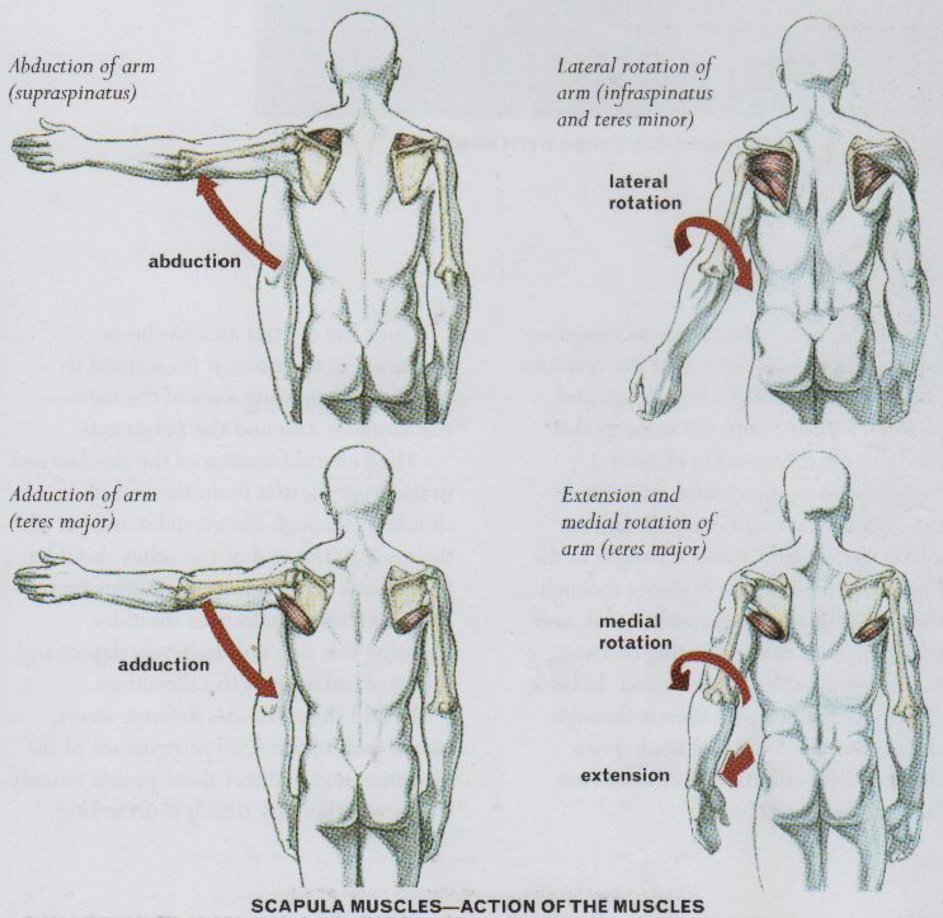
The supraspinatus assists in the action of abducting the arm, which is the raising of the arm away from the side of the torso.

The infraspinatus and teres minor assist in the action of lateral rotation of the arm, which rotates the upper arm outward.

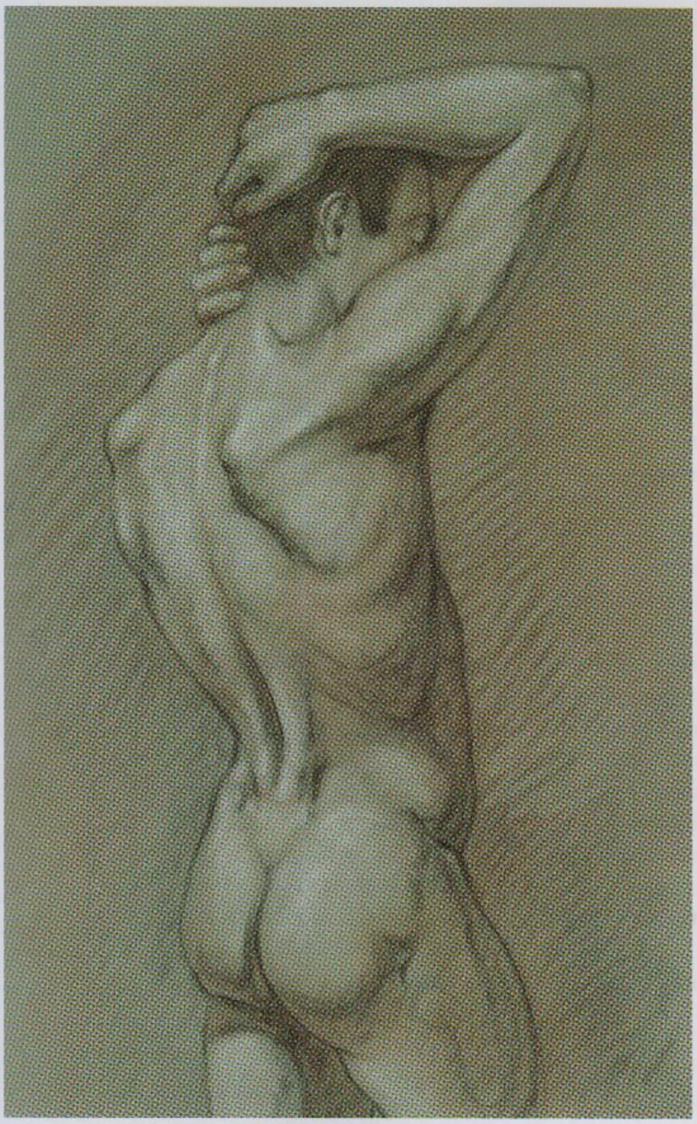
The teres major adducts the arm, which is the action of pulling the arm from a horizontal position back to the side of the torso. It also assists in the movement of rotating the upper arm medially (medial rotation) as well as that of extending the arm.



SCAPULA MUSCLES IN RELATION TO OTHER MUSCLES OF BACK
Posterior view, left shoulder



SCAPULA MUSCLES—ACTION OF THE MUSCLES



STUDY OF BACK TORSO WITH ARMS UP

The Structure and Surface Forms of the Torso

The following pages introduce some additional considerations regarding the structure and forms of the torso. These include the axes of the torso (the central axis, with the shoulder and pelvis axes), two proportional measuring systems, ways of setting up the structure of the torso, understanding the rotation of the torso, and the surface forms of the axilla (armpit) region.

The two proportional canons presented are easy to use because the various divisions occur at skeletal and soft-tissue landmarks. These canons should be used only as a general guide, however, because not everyone's torso will match these idealized breakdowns.

Becoming aware of the torso's structure is very important because it helps train your eye to "see through" the muscular forms and recognize the positions of the ribcage and pelvis. By first establishing a lightly drawn structure, or armature, you can quickly check the proportions and the axes of the torso before building up the detail of the anatomical forms. Setting up a basic structural underdrawing of the torso can be approached in a variety of ways. You can use skeletal, geometric, or organic shapes—or mix the shapes when blocking in the pose. Once the structure is lightly established on the page, then the forms of the muscles can be added.

Axes of the Torso

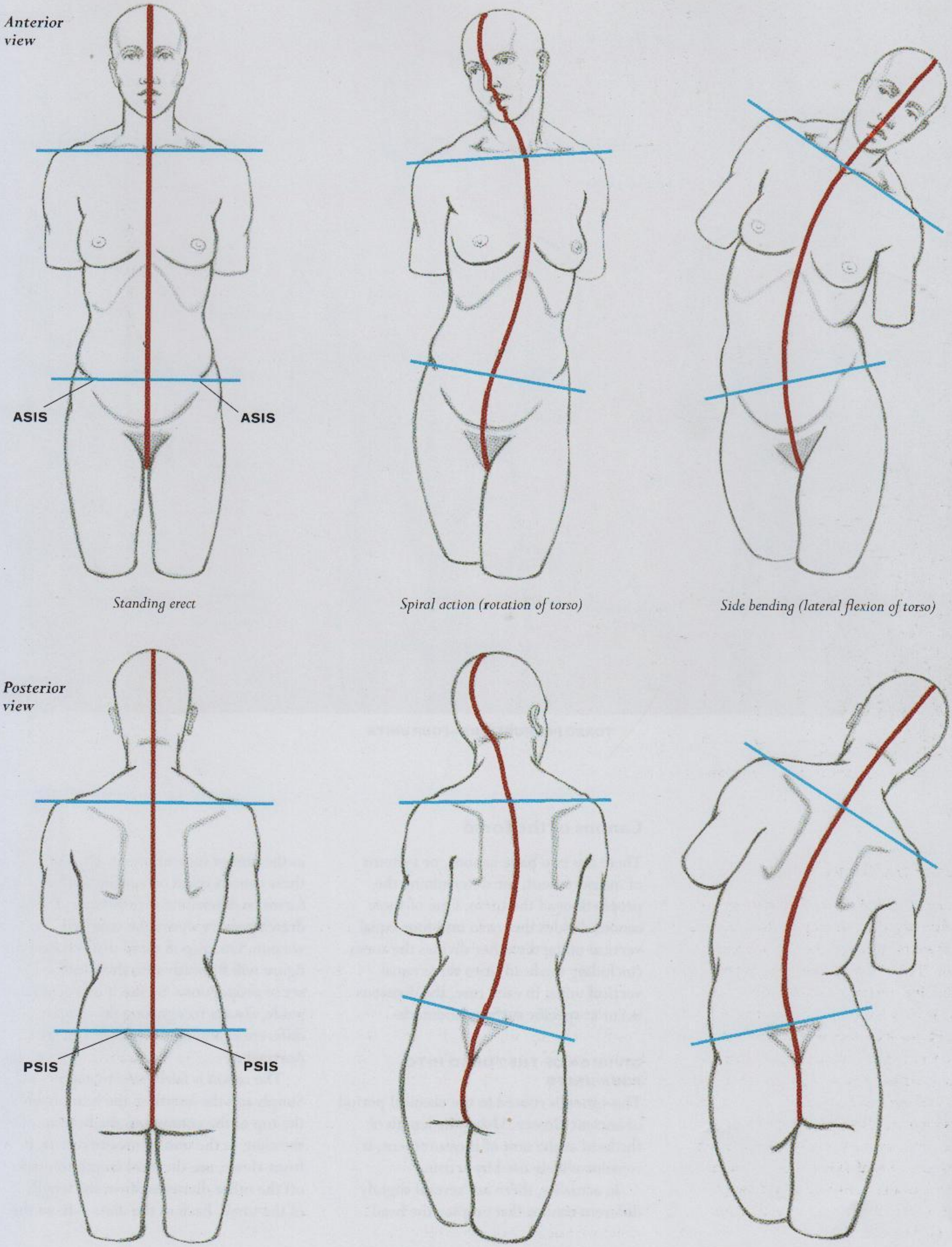
The *central axis of the torso* is an imaginary line that begins at the top of the cranium and channels through the ribcage and pelvis. (This line is to the same as the medial line, discussed in chapter 1.) In front views, the central axis travels through the face and neck all the way down to the pubic bone. Changes in the line's directionality as it passes through the pit of the neck, sternum, navel, and pubis indicate that a pivoting or twisting is occurring in the torso region. In back views, the central axis travels through the back of the head and neck down the vertebral column into the sacrum bone of the pelvis.

Once the central axis has been identified in the pose, it is essential to locate two opposing axes of the torso—the shoulder axis and the pelvis axis.

The general location of the *shoulder axis* in the front view is from the end of one shoulder, through the clavicles and pit of the neck to the end of the other shoulder. In the back view, it is a continuous line running from shoulder to shoulder. Locating this line will help you detect any tilting or rotation of the shoulders.

To find the *pelvis axis* in front views, locate each of the ASIS protrusions of the hip bones and connect these points visually to see whether any tilting is occurring in the pelvis. In back views, locate the sacrum bone and the two small dimples at the top border of the sacrum (the PSIS indentations), drawing an imaginary line through them to assess any tilting or rotation. (If it is hard to locate surface landmarks such as the ASIS or the PSIS, you will have to make an approximate guess as to the placement of the pelvis.)

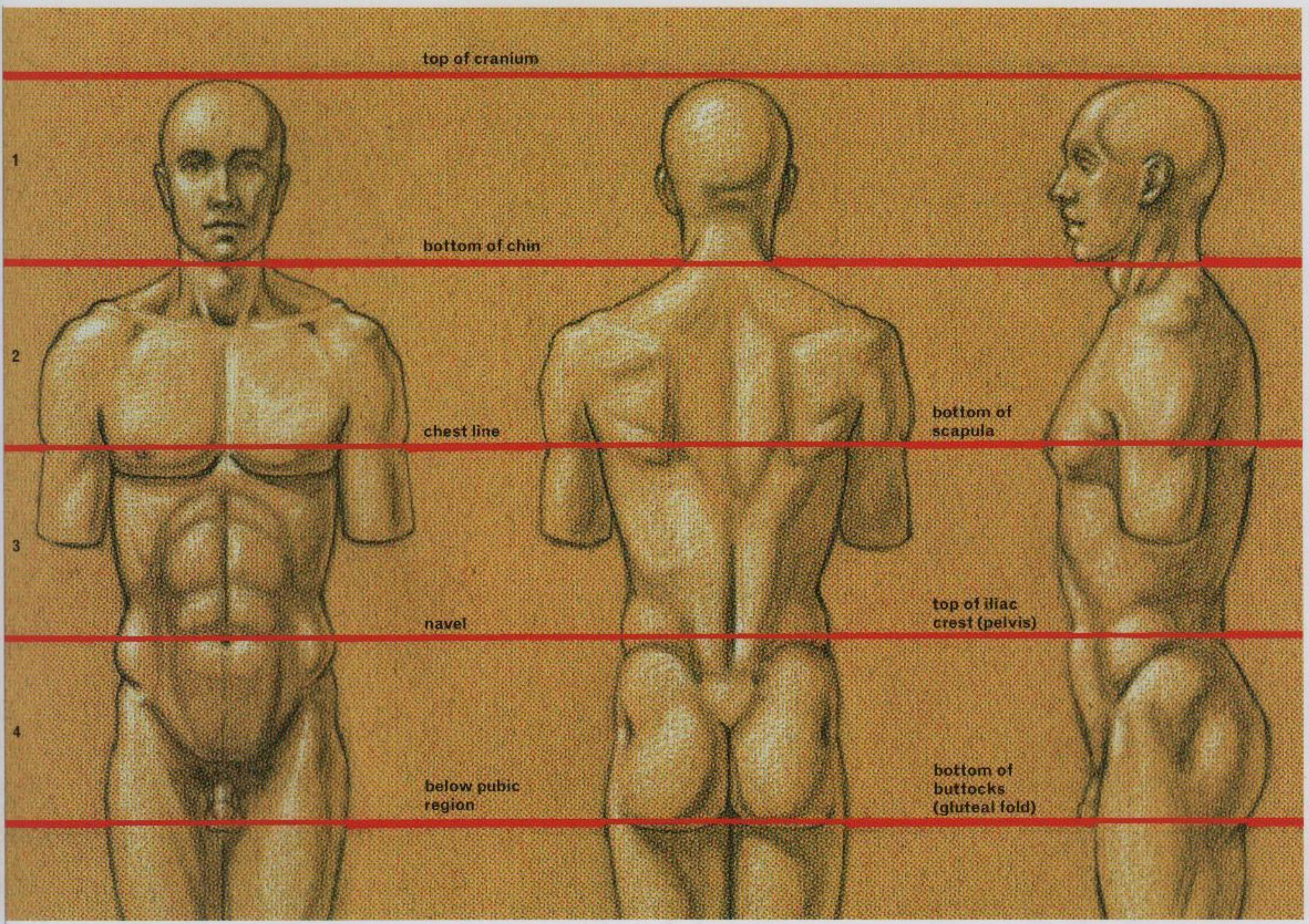
Spiraling movements of the torso occur when the structure of the ribcage is rotated in one direction as the structure of the pelvis is rotated in another direction. This twisting action is also considered a rotational movement of the vertebral column.



Standing erect — *Spiral action (rotation of torso)* — *Side bending (lateral flexion of torso)*

Standing erect — *Spiral action (rotation of torso)* — *Side bending (lateral flexion of torso)*

CENTRAL AXIS OF TORSO WITH SHOULDER AND PELVIC AXES



TORSO PROPORTIONS—FOUR UNITS

Canons of the Torso

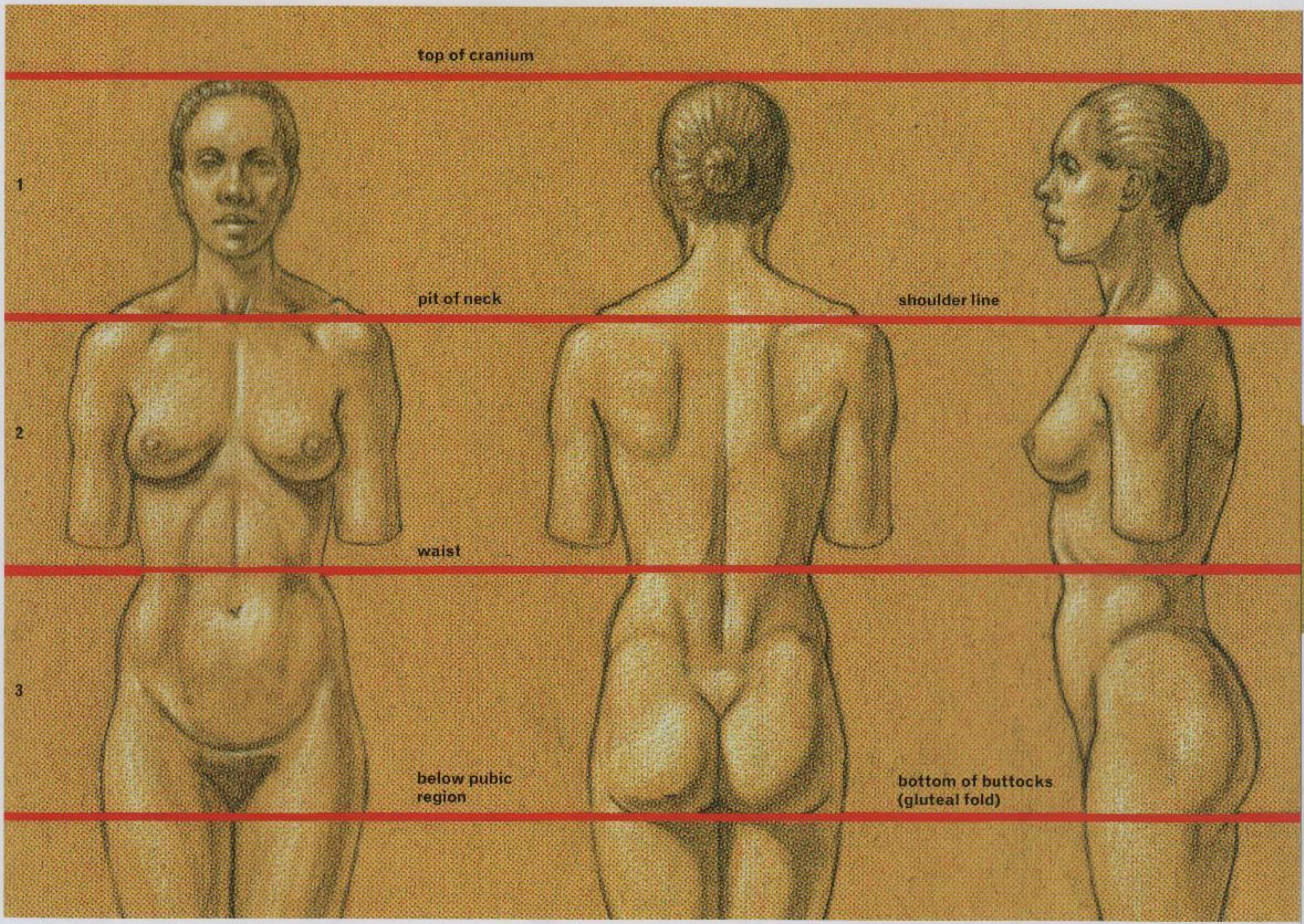
There are two basic canons, or systems of measurement, for determining the proportions of the torso. One of these canons divides the torso into four equal vertical units; the other divides the torso (including the head) into three equal vertical units. In each case, the divisions occur at specific surface landmarks.

DIVISION OF THE TORSO INTO FOUR UNITS

This canon is rooted in the classical period of ancient Greece. Using the length of the head as the unit of measurement, it remains widely used by artists.

In actuality, there are several slightly different canons that employ the head as the unit of measurement. Each of these canons relies on specific surface forms to determine the divisions. The drawing above shows the standard version. Do keep in mind that not every figure will fit neatly into this idealized set of proportions. So use it as a general guide, always recognizing the unique differences among the people you are portraying.

The canon is fairly easy to apply. Simply use the length of the head, from the top of the cranium to the bottom of the chin, as the unit of measurement. In front views, use the head length to mark off the other divisions down the length of the torso. Each of the units—from the



TORSO PROPORTIONS—THREE UNITS

chin to the breast/chest line (through the nipple forms), from the chest line to the navel, and from the navel to the bottom of the pubic area—should be approximately the same length.

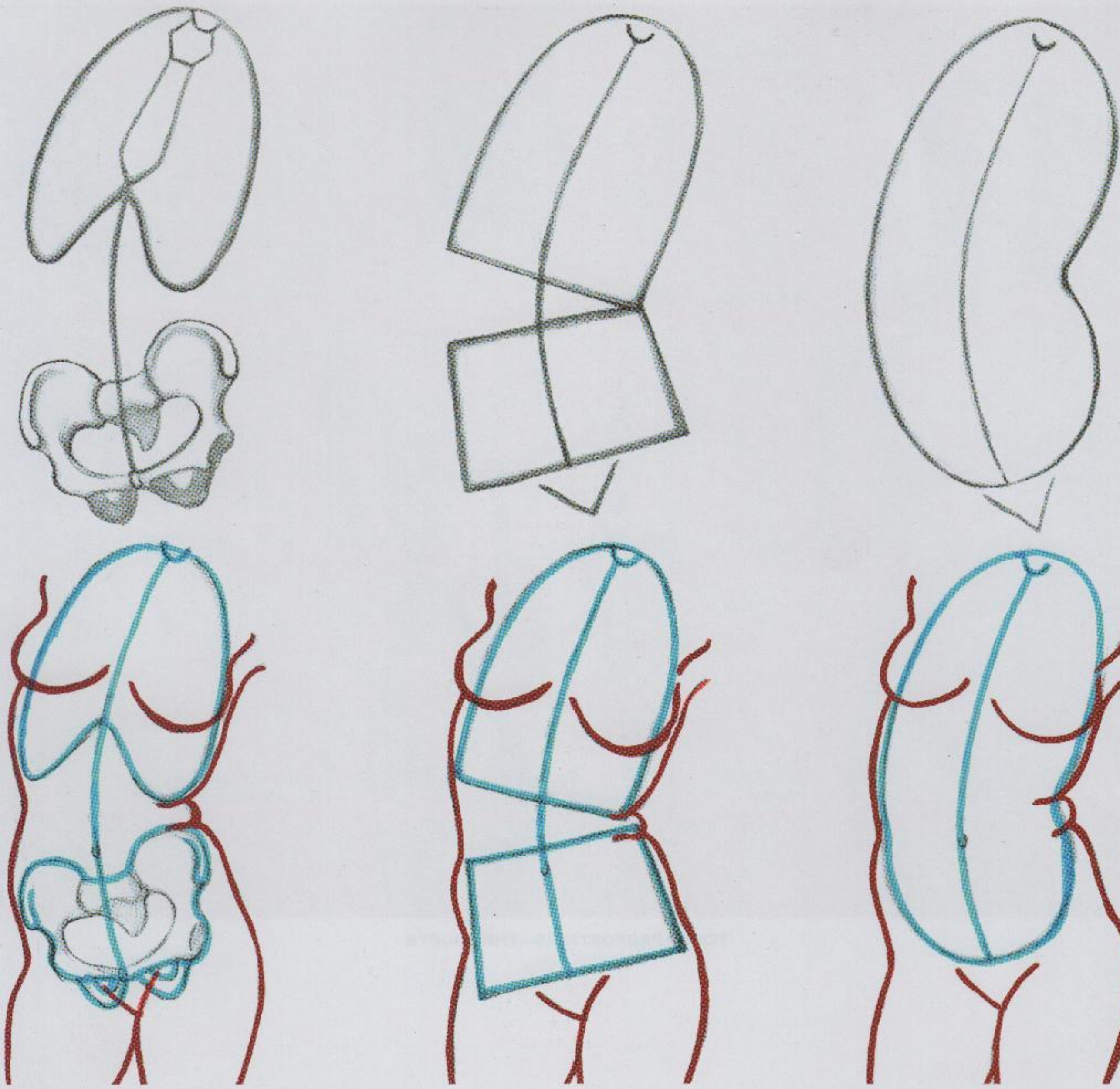
In back views, the same head length can be used to determine the other divisions of the torso: from the chin nearly to the bottom of the scapula bones, from the bottom of the scapula bones nearly to the top of the iliac crest of the pelvis, and from the iliac crest to the bottom of the buttocks.

To measure shoulder width using this canon, double the head length (more or less, depending on the figure) to determine the distance from shoulder to shoulder, using the pit of the neck as the central line of reference in front views. In back views, the seventh cervical vertebra is the central line of reference.

DIVISION OF THE TORSO INTO THREE UNITS

In this canon, the torso (with the head) is conveniently divided into three sections, which correspond to the head and neck region, the ribcage region, and the pelvis region. It works well for both standing and seated poses, provided no foreshortening is occurring in any of the sections.

To establish the three basic units, measure the distance from the top of the cranium to the shoulder line. This then becomes the unit of measurement for the other two sections. The distance from the shoulder line to the waist is more or less equivalent, as is the distance from the waist to the bottom of the pubic region (in front views) or the bottom of the buttocks (the gluteal fold) in back views. This canon allows you to make additional assessments: For example, by dividing the distance from the shoulder line to the waist line in half, you can determine the position of the breast/chest line (usually running through the nipple forms) on the front of the torso or the bottom of the scapula bones on the back of the torso.



Using simplified skeletal shapes *Using geometric shapes* *Using an organic shape*

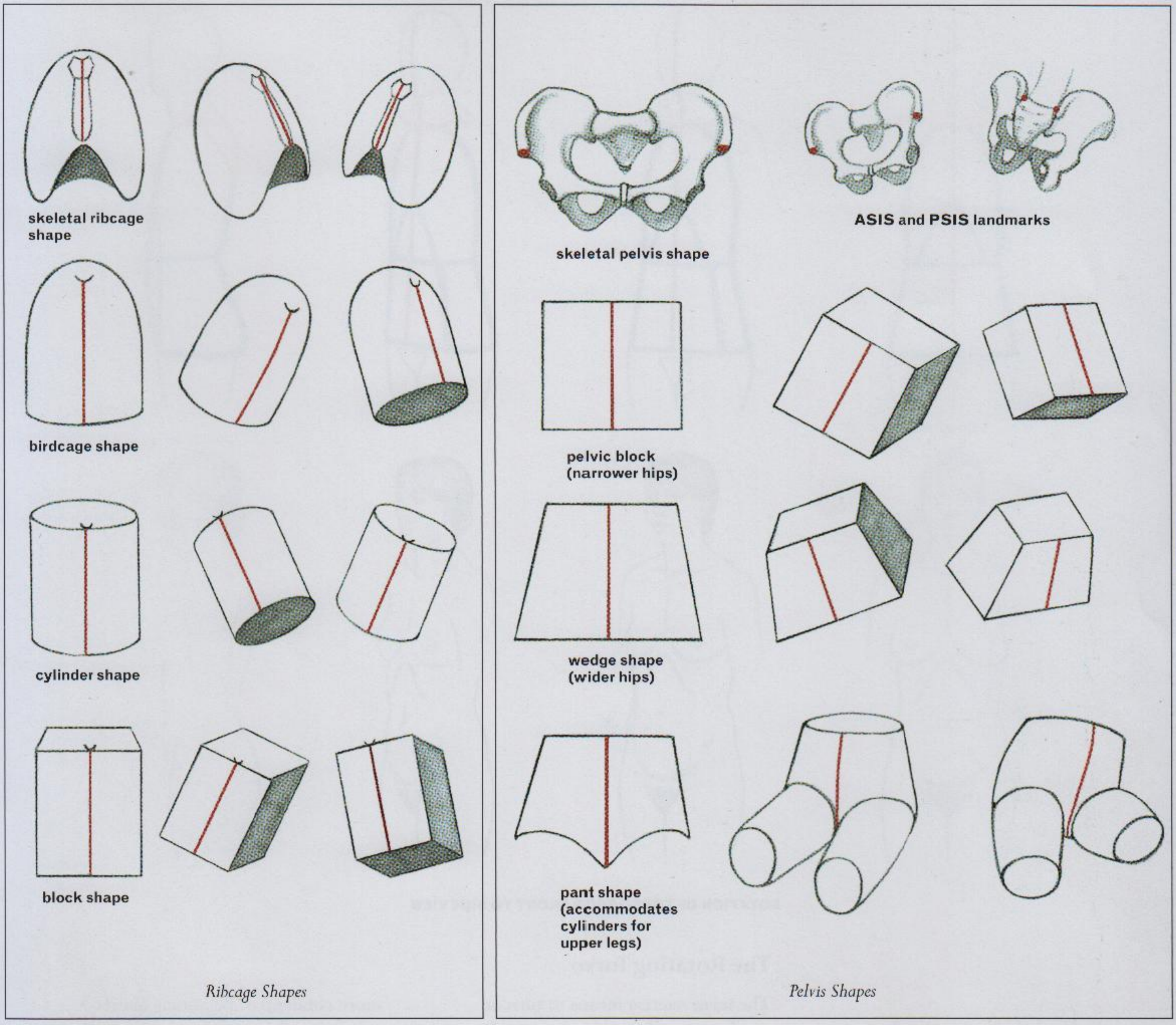
SETTING UP THE TORSO—THREE METHODS

Setting Up the Torso

Many different approaches exist for setting up the general shapes of the torso unit, but the idea of each is to design some sort of preliminary underdrawing as a structural armature onto which the muscular forms can be added. A simple, lightly drawn blocking-in of the general pose can be invaluable because it eliminates the complexities of anatomical detail and allows the artist to first focus on the general placement of the head, neck, ribcage, and pelvis. Indicating the central axis of the torso in this underdrawing will help you establish whether any tilting, bending, or rotation is occurring.

SIMPLIFIED SKELETAL SHAPES

One approach uses simplified skeletal shapes for the underdrawing. In this method, indicating the shape and location of the thorax is fairly easy: You merely use a modified ribcage shape, with the sternum or spinal column as the central axis. It is, however, more difficult to locate the pelvis within the figure. Observing the surface landmarks—the ASIS protrusions on the front, the iliac crest for profile views, and the sacrum bone with the PSIS landmarks for back views—will help you assess the pelvis's approximate position.



RIBCAGE AND PELVIS—REFERENCE SHAPES

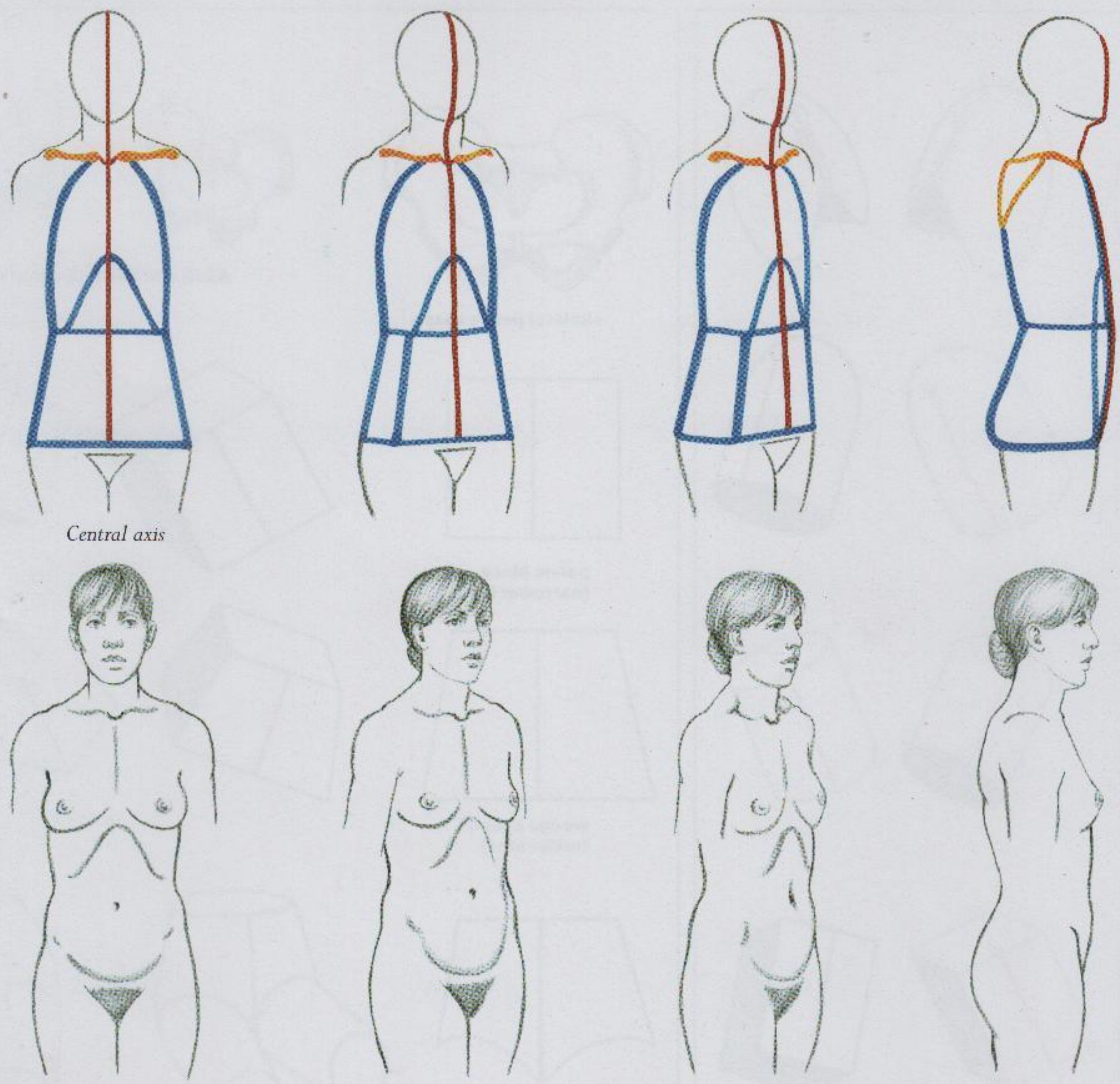
GEOMETRIC SHAPES

Another approach is to set up the underdrawing, or "armature," as a series of geometric shapes that describe the basic structure of each part of the body. These geometric shapes might include cylinders, squares, wedges, or circles, depending on the person being portrayed and the nature of the pose. For example, a wedge shape might work well for the pelvis region of a wide-hipped figure, while a square would be a better choice for a figure with narrower hips. If aspects of the pose are foreshortened, three-dimensional geometric shapes (blocks, cylinders) might work better than two-dimensional squares or elongated rectangles.

FREE-FORM ORGANIC SHAPES

This method takes a freer, more gestural approach to the torso's basic structure, using, for example, a kidney-bean shape, a pear shape, or an egg shape. There is really no formula to this intuitive approach, which uses shapes that seem to work best for a given pose.

Of course, there are no rules saying that you have to stick to one kind of structural format. An artist can mix and match shapes, using a variety of means to map out the basic angles and forms of the torso region. Artists tend eventually to create their own "customized" structures for each study, flexibly addressing the challenges of each new pose. Once the basic armature has been quickly blocked in, the application of the muscular forms can begin.



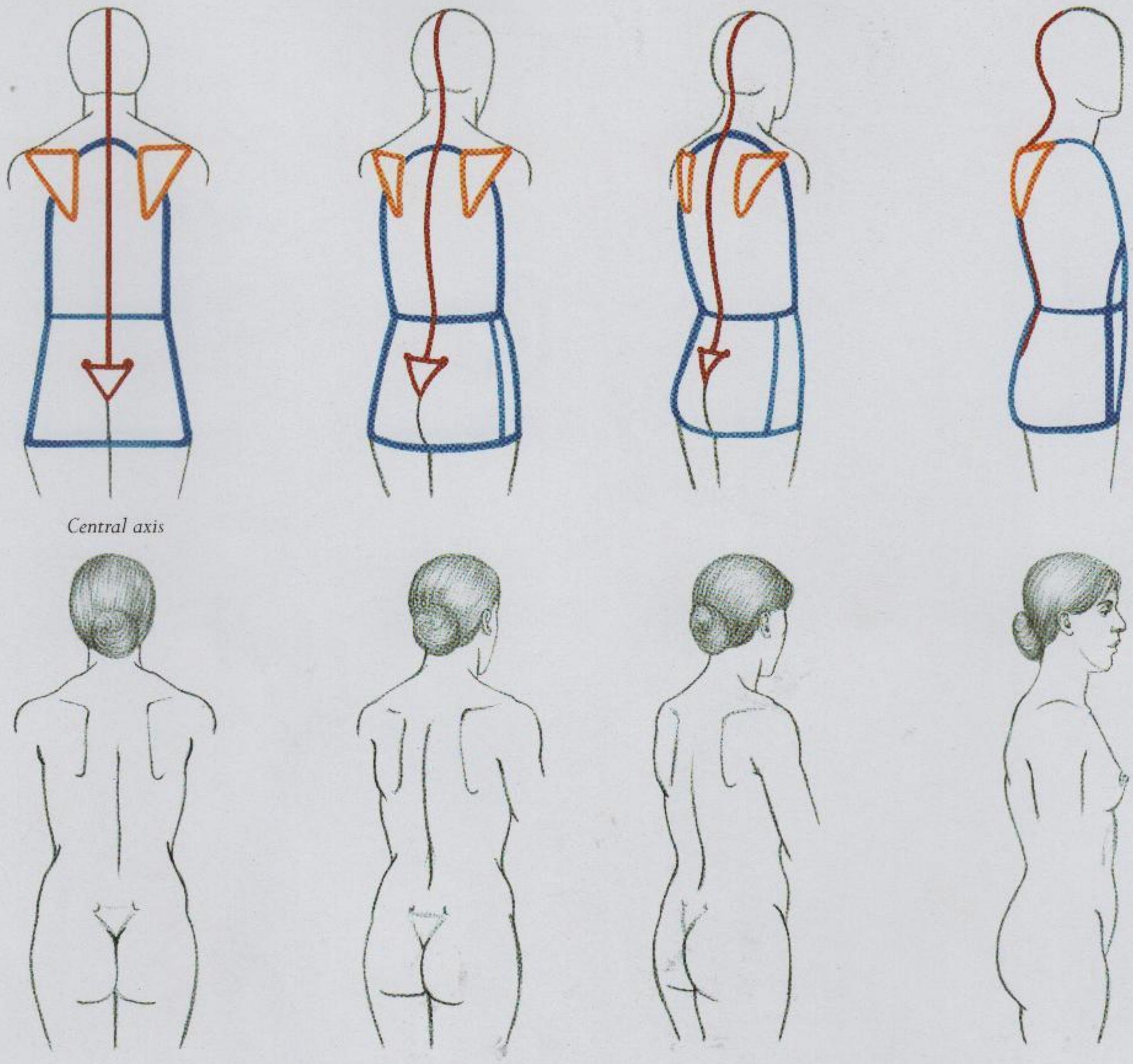
ROTATION OF TORSO FROM FRONT TO SIDE VIEW

The Rotating Torso

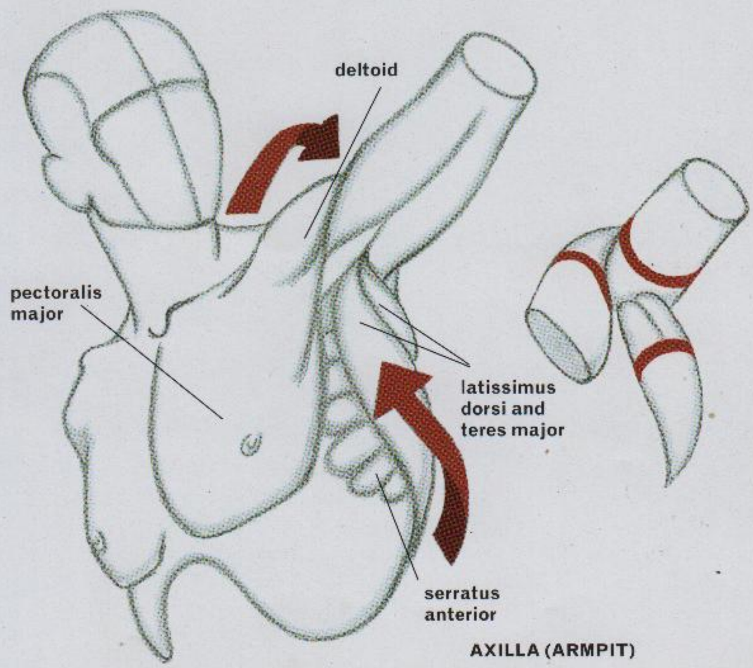
The term *rotation* means to turn or revolve around an axis or center. In the examples in the diagram above, the ribcage and pelvis remain on the same axis as the torso is rotated. (In other words, the ribcage and pelvis are not turning in opposite directions but are rotating together as a single unit.) This kind of rotation can be observed if you walk slowly around a stationary standing figure.

Any view of a standing figure that is somewhere between a straight-on front view (anterior view) and a profile view (side view, or lateral view) is considered a three-quarters view. As the figure rotates away from you, the farther side becomes more condensed. Beginning artists sometimes forget this and make both sides of the figure (that is, either side of the central axis) the same width in a three-quarters view.

When drawing the front of the torso, the key is to locate the central axis as it runs through the head and neck, through the pit of the neck, down the breastbone, through the navel, and into the pubic bone. As the figure rotates, the part of the torso on the farther side of the central axis will diminish, until it is completely hidden in a profile view. The same mechanics apply to the back view of the rotating figure, where the vertebral column defines the central axis.



ROTATION OF TORSO FROM BACK TO SIDE VIEW

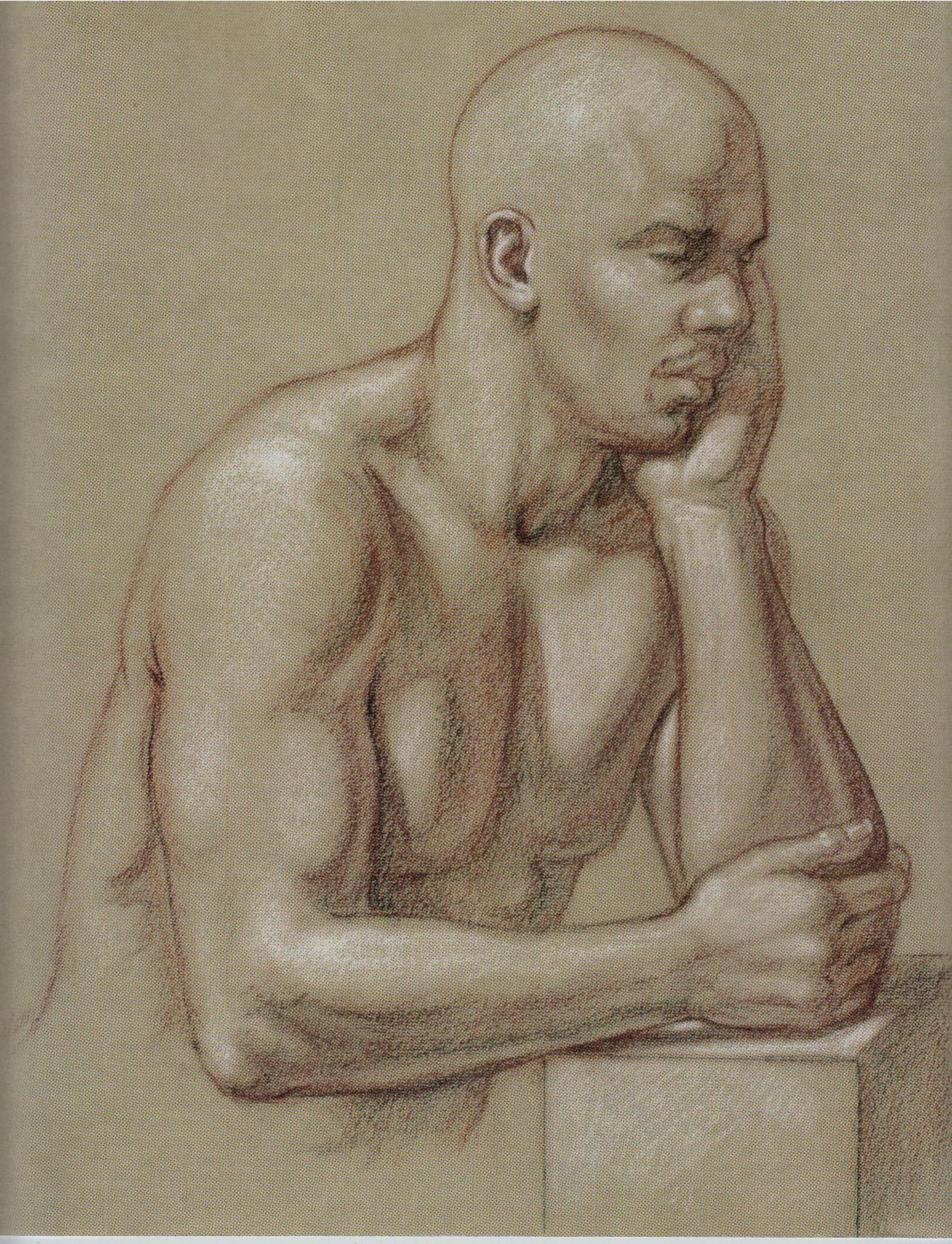


AXILLA (ARMPIT)

Axilla (Armpit)

The axilla, commonly known as the armpit, is a cavity or hollow at the base of the arm that is defined by various muscles, bones, and fascia of the shoulder region. It is divided into sections, generally called the anterior, medial, and posterior walls of the axilla.

The outer portion of the pectoralis major creates the *anterior wall* (front wall) of the axilla. The *posterior wall* (back wall) is created by the latissimus dorsi and teres major. The *medial wall* (inner wall) is created by the upper area of the ribcage and the serratus anterior muscle. The walls of the axilla region are easy to detect on the surface form when the upper arm is moved away from the torso, especially in the action of the abduction of the arm. The interior margins of all these walls, connected by fascia and skin, together define the *floor of the axilla*.



Chapter 4 The Arm

The structural forms of the upper and lower arm are relatively easy to depict because of their cylindrical shapes. Learning the basic joints—the ball and socket joint of the shoulder, the hinge joint of the elbow region, and the pivot joint at the elbow (which rotates the lower arm)—will help you understand the mechanics of movement.

The humerus bones of the upper arms are connected to the skeletal *shoulder girdle* (or *pectoral girdle*), which consists of the scapula bones (shoulder blades) and clavicles (collar bones). The muscles of the shoulder girdle help move the humerus, clavicle, and scapula to various positions, depending on the particular actions of the muscles involved.

The pectoralis major, deltoid, latissimus dorsi, and the muscles of the scapula (scapula group) all contribute to the actions of flexion, extension, abduction, adduction, and rotation of the humerus. The muscles that move the scapula in the movements of elevation, abduction, adduction, and upward and downward rotation are the serratus anterior, rhomboid major, rhomboid minor, and trapezius. The upper portion of the trapezius assists in the elevation of the clavicle. These muscles were introduced in the previous chapter because their muscular shapes contribute dynamically to the forms of the torso. They all play a pivotal role, however, in the action of the upper arm.

The biceps brachii and the triceps brachii also attach on the scapula. Occupying the anterior and posterior portions of the humerus, these muscles help in the flexion and extension of the lower arm. Their obvious shapes are easily recognized by artists (as is the shape of the deltoid).

The muscles of the lower arm take on a fleshier characteristic in the upper half of the forearm and then become more angular toward the wrist because of the elongated tendons riding close to the bones. They help in the extension and flexion of the fingers and hand and the radial abduction and ulnar adduction of the wrist, and they assist in the rotation (supination and pronation) of the lower arm.

Note that in most anatomy books, the upper arm and lower arm are together designated as the *upper limb* (and the upper leg and lower leg are together referred to as the *lower limb*). The term *arm* is reserved anatomically to refer only to the upper arm, or *brachium,* which contains the humerus bone. The term *forearm* (or *antebrachium*) refers to the lower arm, which contains the two bones called the radius and ulna.

In common usage, however, *arm* usually refers to both the upper and lower portions. For the sake of clarity, we'll follow common usage here, using the terms *upper arm* and *lower arm* to differentiate the two parts of the whole arm.

Opposite: **HEAD AND ARMS**

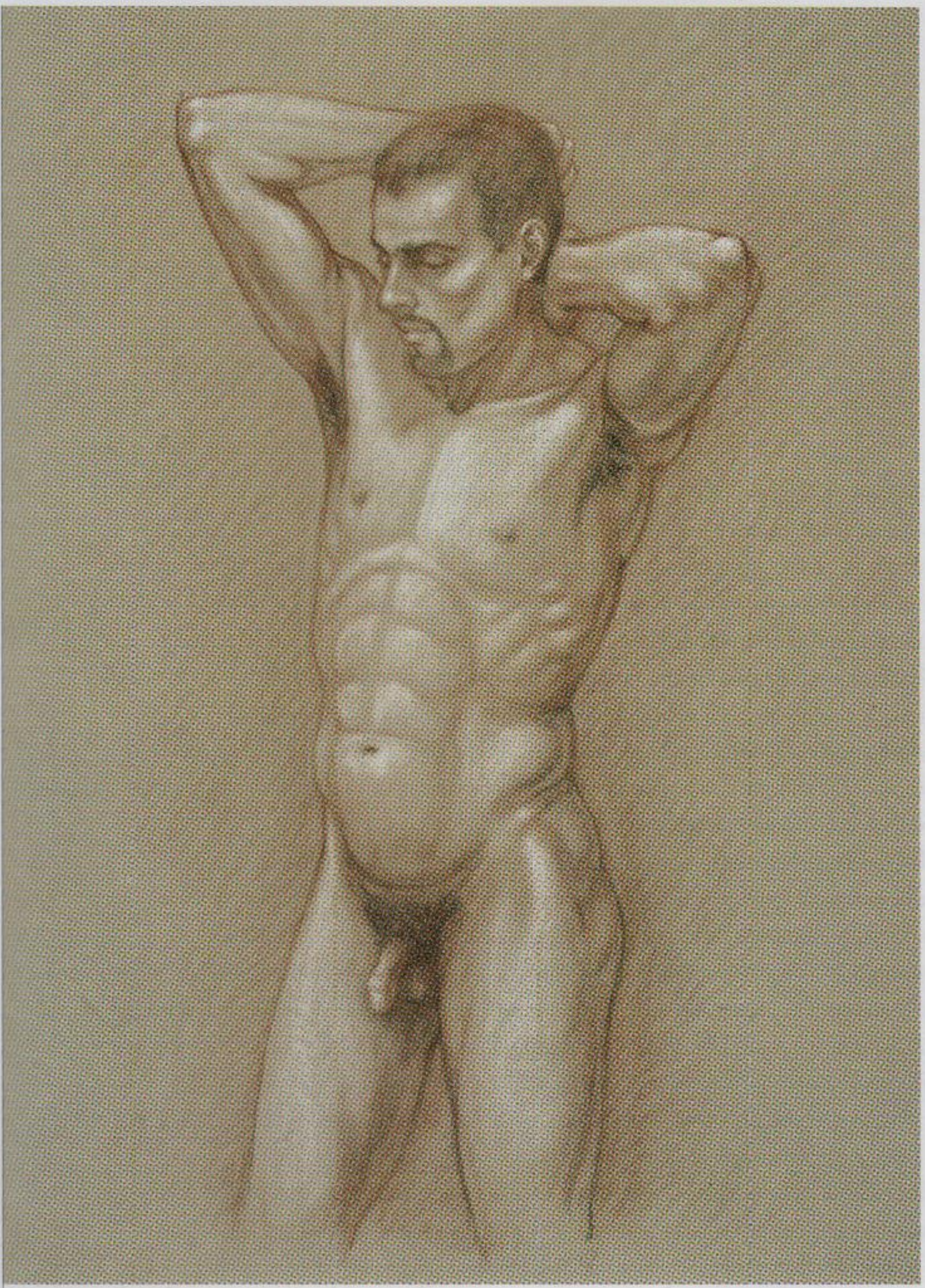
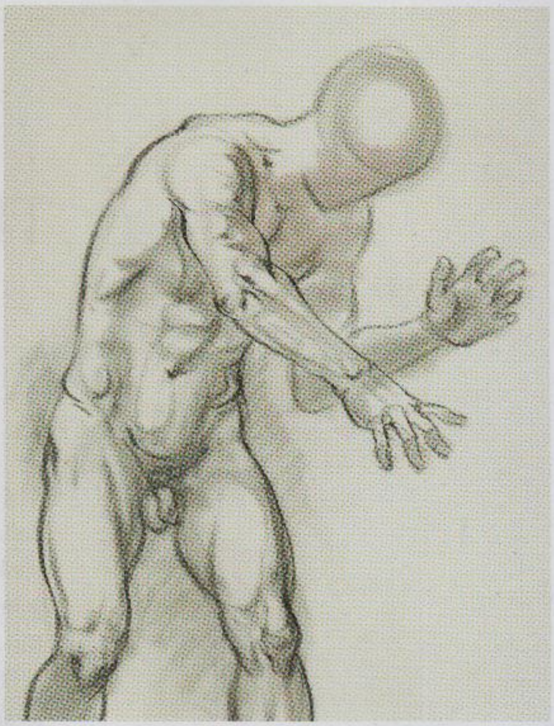
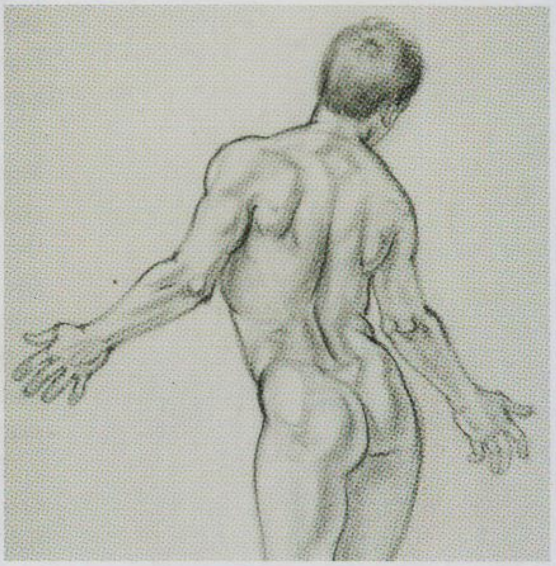


FIGURE WITH ARMS UP

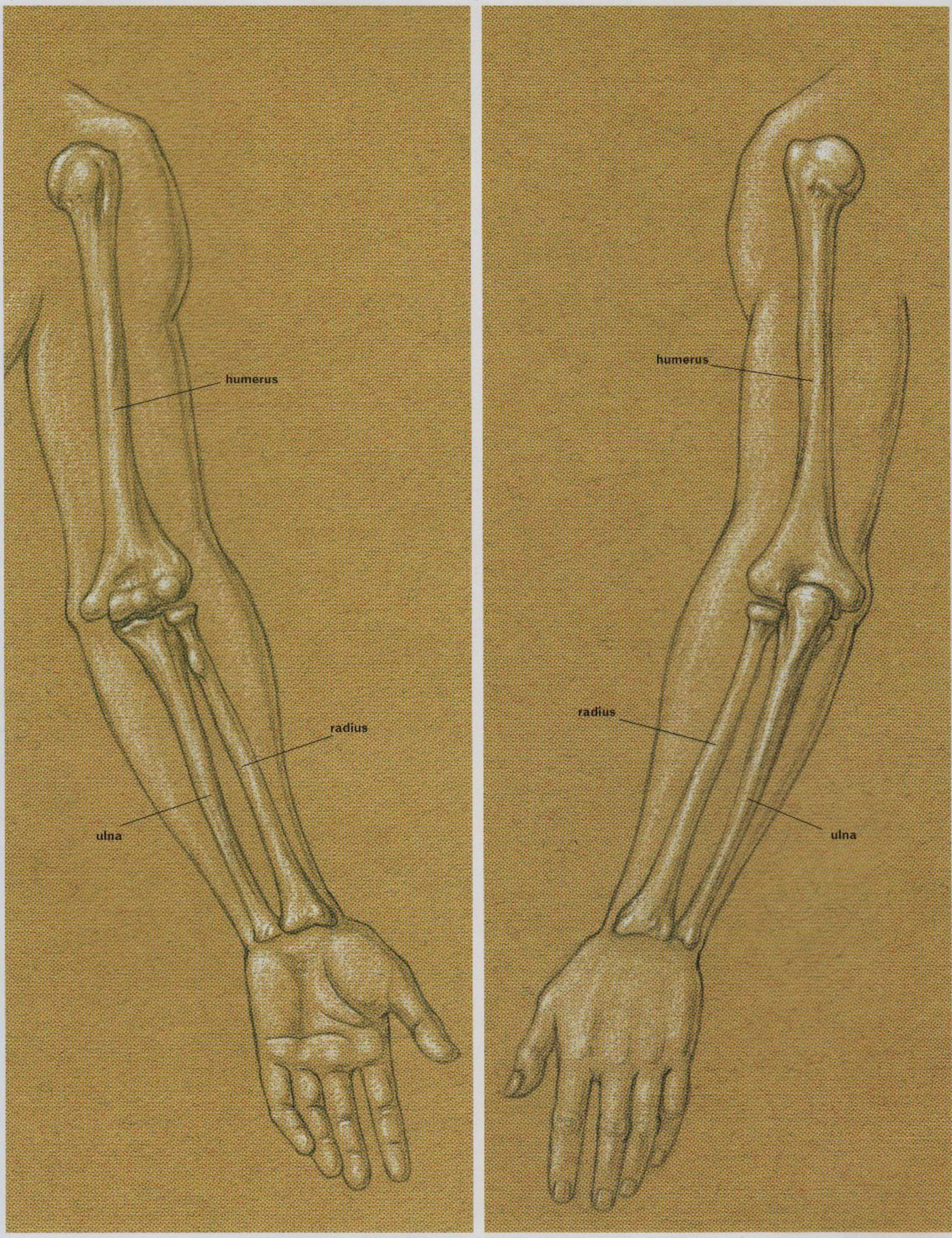




Top: **GESTURE STUDY OF DYNAMIC ARMS**
Bottom: **GESTURE STUDY OF ARMS HELD OUTWARD**

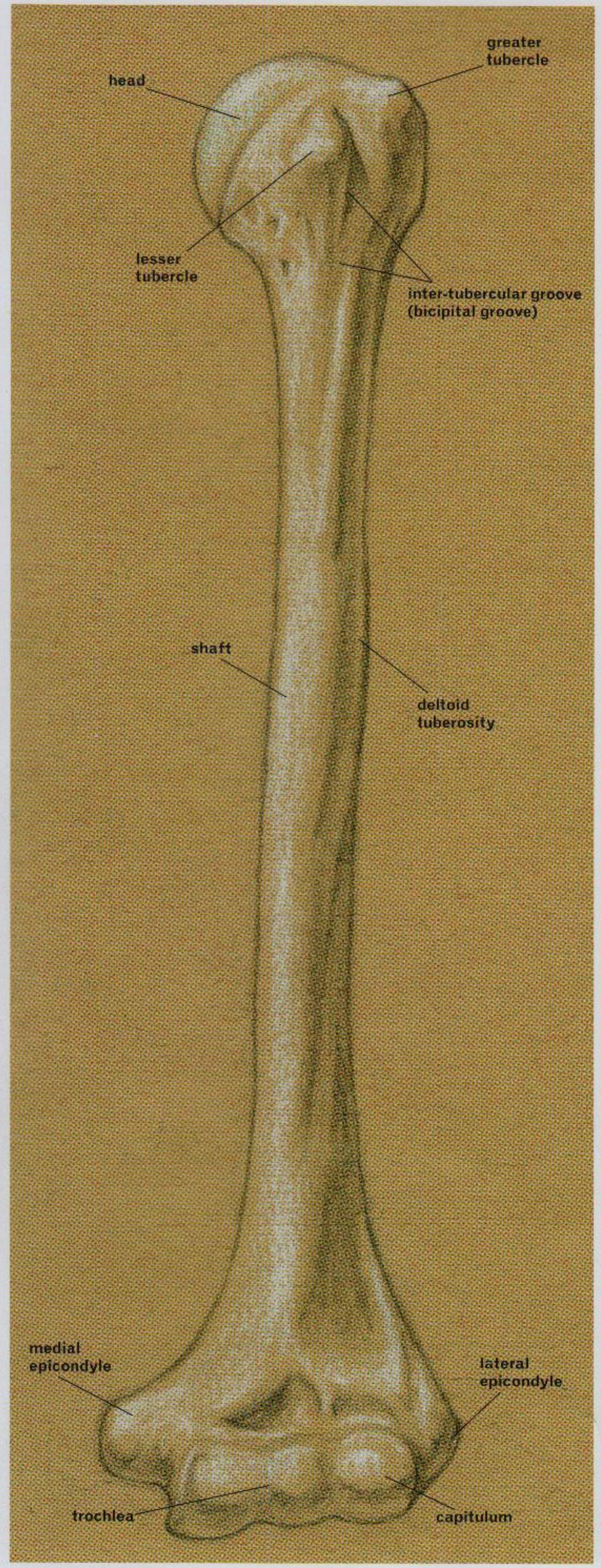
The Bones of the Upper and Lower Arm

The skeleton of the upper limb consists of three bones: the humerus of the upper arm and the radius and ulna of the lower arm. When the arm is in the anatomical position, the radius and ulna are parallel to each other. When the hand rotates, the bones of the lower arm cross over each other. Observing the bony landmarks of the arm bones on the surface form will help indicate their placement within the forms of the arm. Being aware of the placement of these bones is essential for understanding and identifying the muscles of the arm in their many different positions.

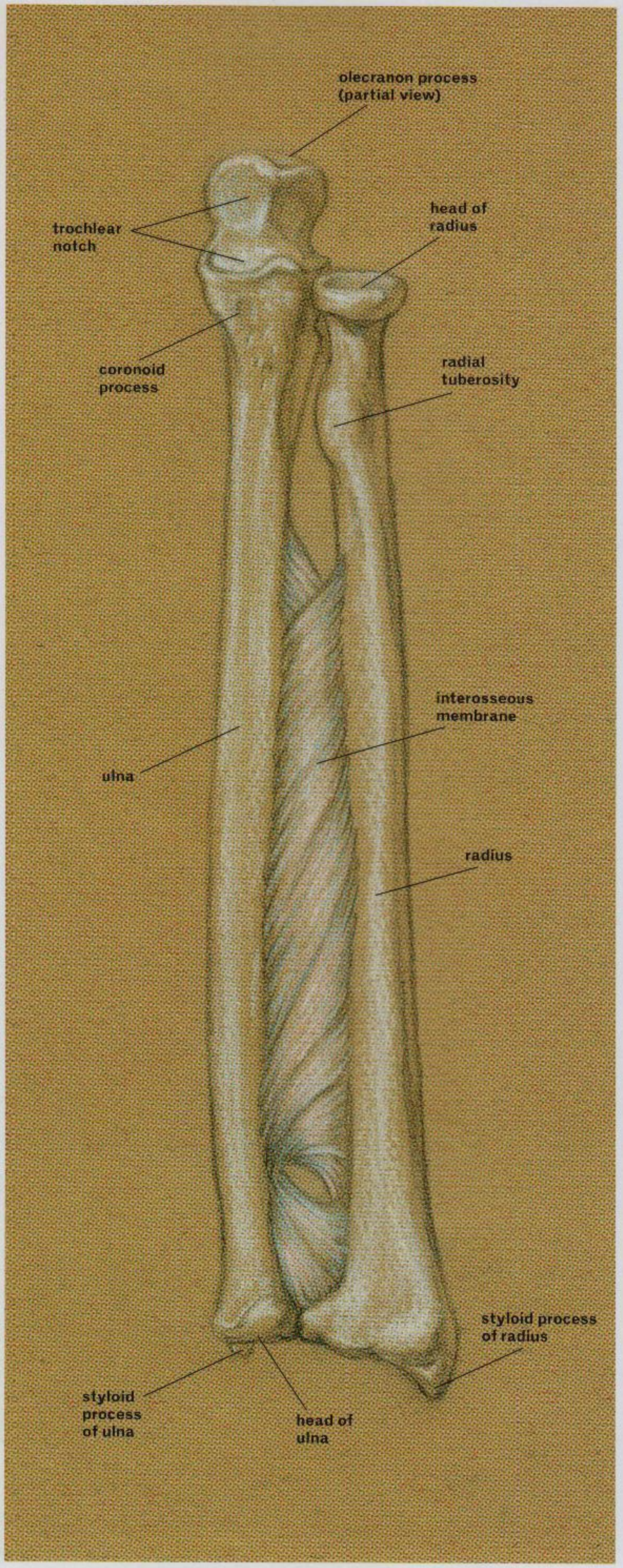


BONES OF THE UPPER AND LOWER ARM (ANATOMICAL POSITION)

Left: Anterior view of upper and lower left arm. Right: Posterior view of upper and lower left arm.



HUMERUS (ANTERIOR VIEW, UPPER LEFT ARM)



ULNA AND RADIUS (ANTERIOR VIEW, LEFT ARM)

Humerus

The upper arm bone is called the humerus. Classified as a long bone, the humerus is the largest bone of the whole arm.

The *head of the humerus* is shaped like a golf ball that has been cut in half and tilted at an angle. The head articulates with the glenoid fossa of the scapula (the socket of the shoulder blade) to create the ball and socket joint of the shoulder.

On the lateral side of the head is an angular projection called the *greater tubercle*; near it, but more toward the front, is a smaller projection called the *lesser tubercle*. The greater tubercle projects slightly beyond the acromion of the scapula under the deltoid and contributes to the round quality at the end of the shoulder. The greater and lesser tubercles are attachment sites for the scapula muscles. Between these two forms lies a trench-like depression called the *inter-tubercular groove* (or *bicipital groove*), which is occupied by the long tendon of the biceps brachii muscle, coming from its origin above the glenoid fossa of the scapula.

About midway down the shaft of the humerus is a textured, V-shaped area called the *deltoid tuberosity*. This is the attachment site for the deltoid muscle of the shoulder. The cylindrical shaft of the humerus becomes more angular as it approaches its lower end, where it begins to flare outward to form two prominent projections, one on either side of the main body of the bone. These are called the *lateral epicondyle* (on the outside) and the *medial epicondyle* (on the inside).

The medial epicondyle, which is slightly sharper, is the more prominent and serves as an attachment site for the flexor muscles of the lower arm. On the living figure, it forms a small bump on the surface near the elbow. This area is colloquially known as the funny bone (which is a play on words, because the word *humerus* sounds just like the word *humorous*). The ulnar nerve runs close to the medial epicondyle, and when this nerve is bumped, it produces a strange, tingling—funny—sensation. The smaller, blunter lateral epicondyle serves as an attachment site for the extensor muscles of the lower arm. When the arm is straightened it is usually hidden by muscles, but when the arm is flexed (bent) a small protrusion will be noticeable on the surface form.

Between the epicondyles are two bony structures called the *trochlea* and the *capitulum*. The trochlea (which looks like a spool laid on its side), and the capitulum (which resembles a sphere) articulate with the ulna and radius of the lower arm to create the elbow joint.

Humerus

PRONOUNCIATION
HYOO-murr-us

ORIGIN OF THE TERM
Latin *humerus* = shoulder

SYNONYMS
upper arm bone, os brachii

Ulna

PRONOUNCIATION
ULL-nah

ORIGIN OF THE TERM
Latin *ulna* = elbow

SYNONYMS
cubitus, lower arm bone (along with the radius)

Radius

PRONOUNCIATION
RAY-dee-us *or* ray-DEE-us

ORIGIN OF THE TERM
Latin *radialis*, from *radius* = ray, rod, or spoke of a wheel

SYNONYM
lower arm bone (along with the ulna)

Ulna

The ulna is the longer of the two bones of the forearm. When the whole arm is in the anatomical position, the ulna is located medially (that is, on the same side as the little finger of the hand). In this position, it is parallel to the other, shorter bone of the forearm, the radius. The upper end of the ulna is thick and bulky; from there, the shaft tapers to a much smaller, thinner lower end.

At the upper end of the ulna is the *olecranon process*, a small, boxlike bony prominence that forms the tip of the elbow. On the anterior view of the upper part of the ulna, directly in front of the olecranon, is a large, C-shaped form called the *trochlear notch*, which resembles a crescent wrench. This notch articulates with the trochlea, at the lower end of the humerus, to create the elbow joint.

The ulna curves gently downward, tapering toward the round *head of the ulna*, which can be clearly seen as the small, lateral bump near the wrist (on the little finger side of the hand). On the head of the ulna is a small spur of bone called the *styloid process*, which projects downward. When the arm is pronated (with the palm facing toward the back), the head of the ulna can clearly be seen on the surface form; when the arm is supinated (palm facing toward the front), the styloid process can occasionally be seen.

The *posterior border* of the ulna is a crest-like edge that appears near the elbow and travels all the way down the bone to the head of the ulna. Two elongated muscles that bulge slightly on either side of the posterior border produce the *ulna furrow*, which can be seen on the surface form as a skinny, elongated shadow or tone along the entire length of the forearm. One of the easiest ways to locate the ulna within the forearm is to observe the placement of the elbow (olecranon) and follow the ulnar furrow toward the wrist. This subtle line serves as a landmark for the placement of the various muscles that attach near or along the ulna.

Radius

When the arm is in the anatomical position, the radius is positioned laterally (that is, on the same side as the thumb) and parallel to the ulna. The radius is shorter than the ulna.

In its basic characteristics, the radius is almost the opposite of the ulna. The upper part of the radius is very slender; the bone curves downward to a wider lower end. The *head of the radius*, at the upper end of the bone, is shaped like a small, thick wheel with a tapered neck. Below the head is a small prominence called the *radial tuberosity* (or *bicipital tuberosity*) where the tendon of the biceps brachii muscle inserts. The *styloid process of the radius* is a pointy protrusion that hangs downward from the bone's lower end. On the surface form, it is concealed by the two lateral tendons of the so-called snuffbox muscles (the abductor pollicis longus and the extensor pollicis brevis).

Elbow Joint

SYNONYMS
articulatio cubiti (TA), cubital joint

Elbow Joint—Basic Forms

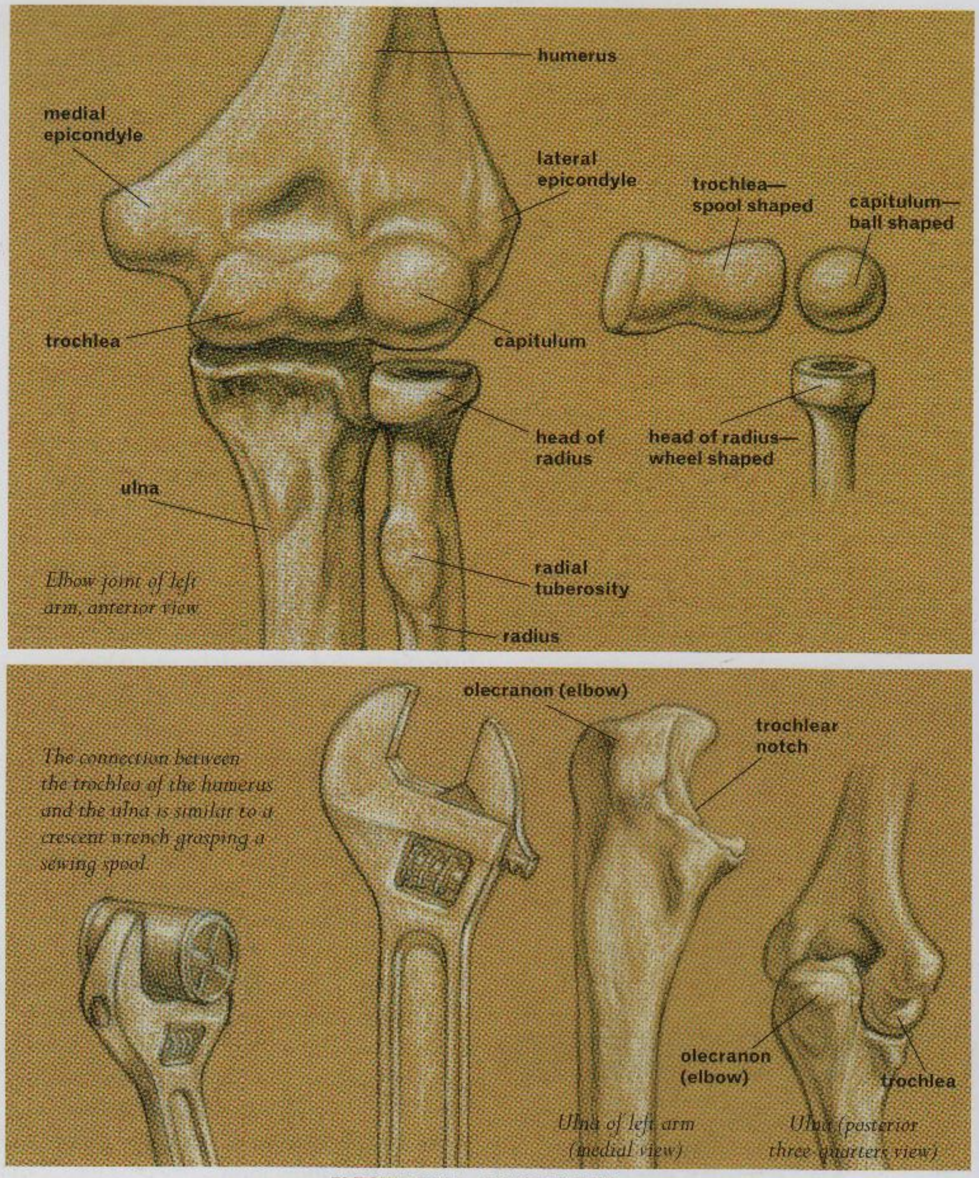
The joint between the upper arm bone (humerus) and the two lower arm bones (radius and ulna) is referred to as the elbow joint. It most often functions as a hinge for the bending and straightening of the lower arm, but because of its unique design, the elbow joint can also produce the movement of rotation of the lower arm.

At the base of the humerus, on the anterior side and positioned between the epicondyles, are the structures called the trochlea and the capitulum. These bony components are designed to accommodate both the movement of the hinge joint of the elbow and the rotation of the lower arm. The trochlea, which looks like a spool laid on its side (or an hourglass), articulates with the trochlear notch of the ulna, which resembles the head of a crescent wrench. The trochlear notch clamps around the spool-like trochlea to create the hinge joint of the ulna. This joint permits only the movements of flexion and extension (bending and straightening) of the lower arm.

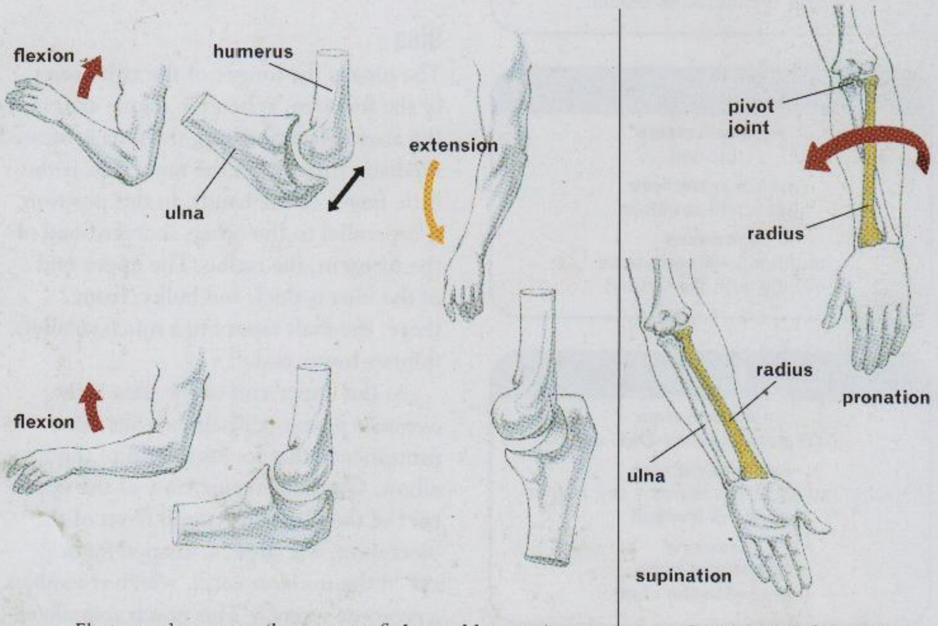
The capitulum, which is shaped like half of a ball, lies next to the trochlea. This form articulates with the wheel-shaped head of the radius bone. A ring of ligament called the *annular ligament* (not shown) attaches on the ulna and encases the head of the radius like a tight sling. The radius can rotate freely within it, beneath the capitulum, creating a pivot joint that enables the actions of pronation and supination of the lower arm. When the radius is rotated, it crosses over the ulna, and the two bones form an X configuration.

The olecranon—the prominent bump commonly known as the elbow—is positioned at the upper posterior portion of the ulna. When the arm is straight, the olecranon aligns with the two epicondyles of the humerus. As the lower arm bends, the hinge-like movement causes the olecranon to swing slightly downward.

Several ligaments attach on the bones of the elbow joint, creating the outer portion of the *joint capsule* that contains the synovial membrane. Many skeletal muscles attach on or near the bones of the elbow joint.



ELBOW JOINT—BASIC FORMS



Flexion and extension (hinge joint of ulna and humerus)

Supination and pronation (pivot joint of radius and ulna)

ELBOW JOINT—MOVEMENT

The Muscles of the Upper and Lower Arm

The muscles of the upper arm, which include the deltoid, biceps brachii, and triceps brachii, are fairly well known by most figurative artists. They produce simple, obvious shapes on the surface form, which are easy to identify in a variety of poses.

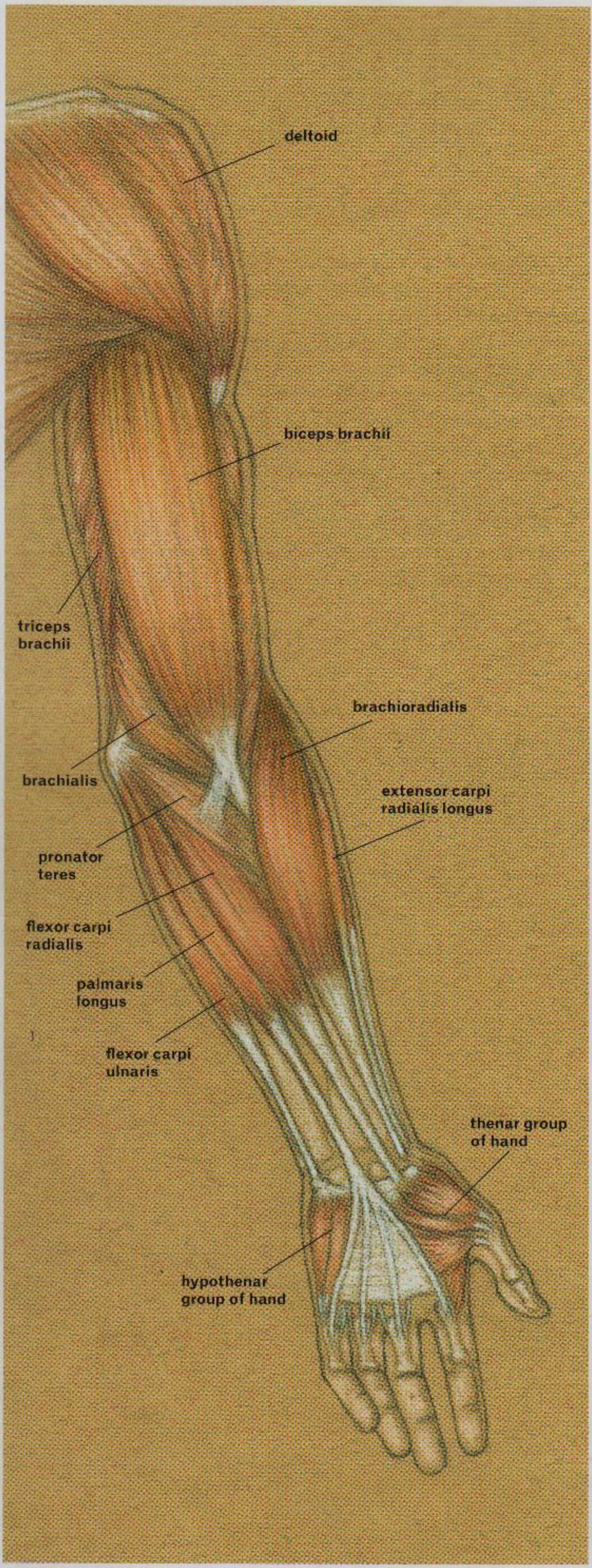
The muscles of the lower arm are, however, a bit trickier because many have similar names and their individual muscular shapes are somewhat alike in character. They are also a challenge to learn and locate because of the rotation that occurs in the lower arm, which can cause the muscles to spiral or twist. First becoming familiar with the muscles of the forearm as they appear in the anatomical position will help you to recognize their shapes when the lower arms are turning and twisting in various action poses. Keep in mind that the anatomical terms relate to the *anatomical position* of the upper and lower arm. For example, in regard to the muscles of the lower arm, the muscles whose names include the term *flexor* are positioned on the anterior part of the forearm, whereas the muscles whose names include the term *extensor* are positioned on the posterior part of the forearm. Remembering this will help prevent you from becoming confused because of the similarities of so many of the muscles' names.

Muscles of the Upper Arm

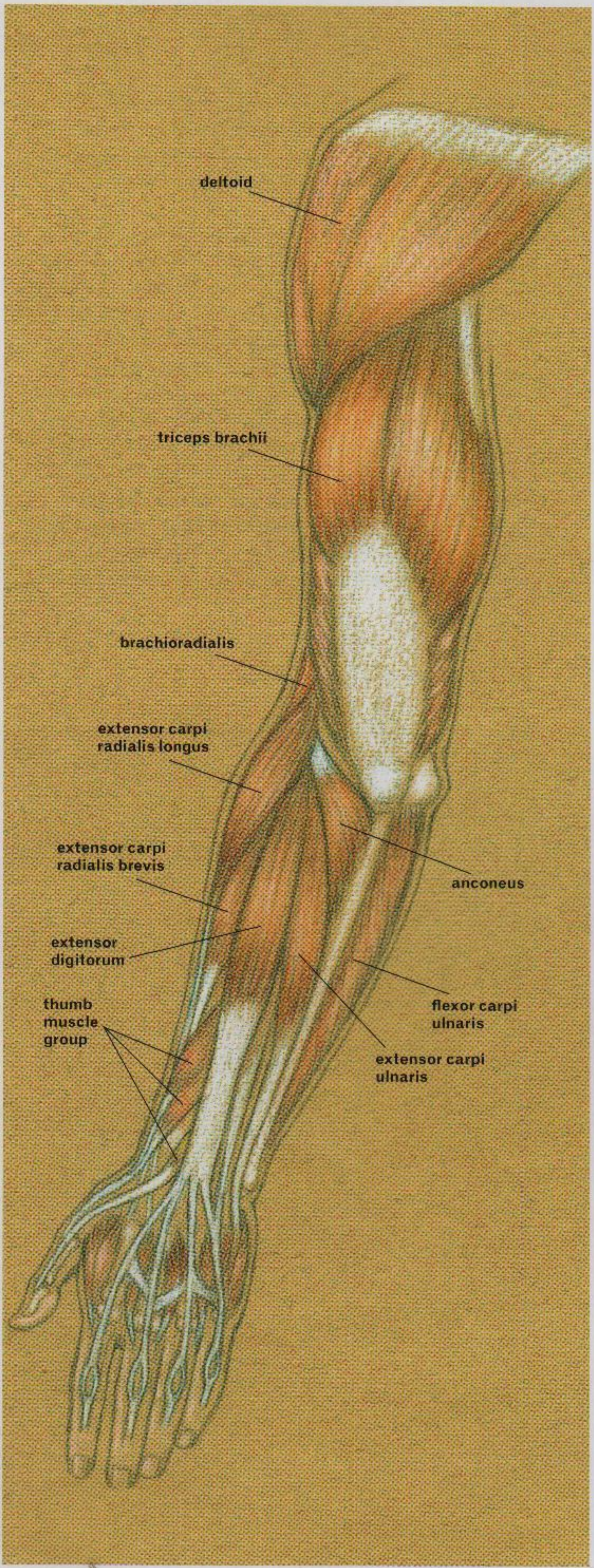
The muscles of the upper arm are divided into two groups: the *flexor group,* primarily located in the anterior (front) portion of the arm, and the *extensor group,* located in the posterior (back) portion of the arm. These muscles move the elbow joint and forearm. (Actually, the terms *flexing the forearm* and *flexing the elbow joint* mean the same thing. Both denote the action of bending the forearm at the elbow, with the lower arm moving toward the upper arm. Likewise, the terms *extending the forearm* and *extending the elbow joint* have the same meaning: the action of straightening the forearm from a flexed or bent position.)

The principal flexors of the upper arm are the *biceps brachii,* the *brachialis,* and the *brachioradialis* muscles. The principal extensors of the upper arm are the *triceps brachii* and *anconeus* muscles.

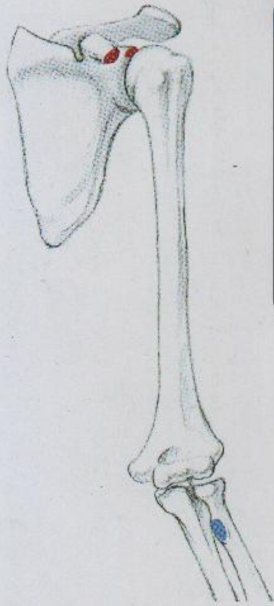
STUDY OF EXTENDED ARM HOLDING POLE



MUSCLES OF UPPER AND LOWER ARM (ANTERIOR VIEW, LEFT ARM)



MUSCLES OF UPPER AND LOWER ARM (POSTERIOR VIEW, LEFT ARM)



Biceps Brachii

PRONOUNCIATION
BI-seps BRAY-kee-ee
or
BI-seps BRAKE-ee-eye

ORIGIN OF THE TERM
Latin *bi* = two + *caput* = head + *brachium* = arm

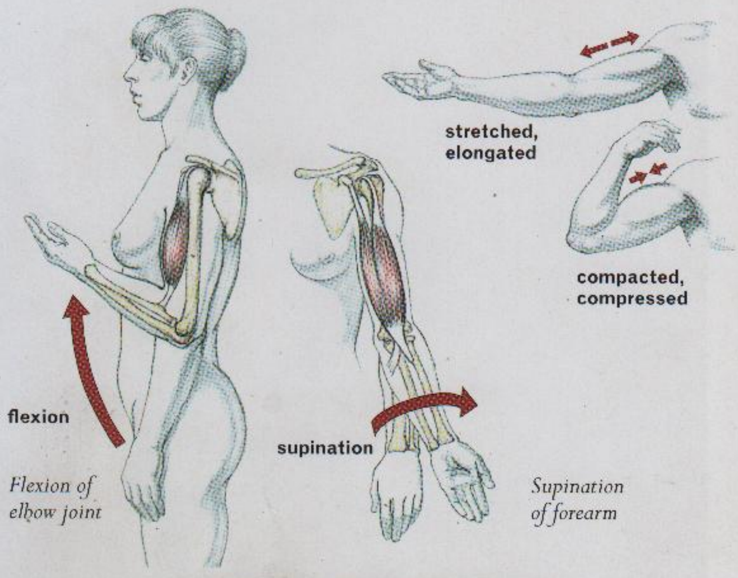
SYNONYMS
musculus biceps brachii (TA), biceps flexor cubitus, biceps anticus, biceps

BICEPS BRACHII—MUSCLE ATTACHMENTS

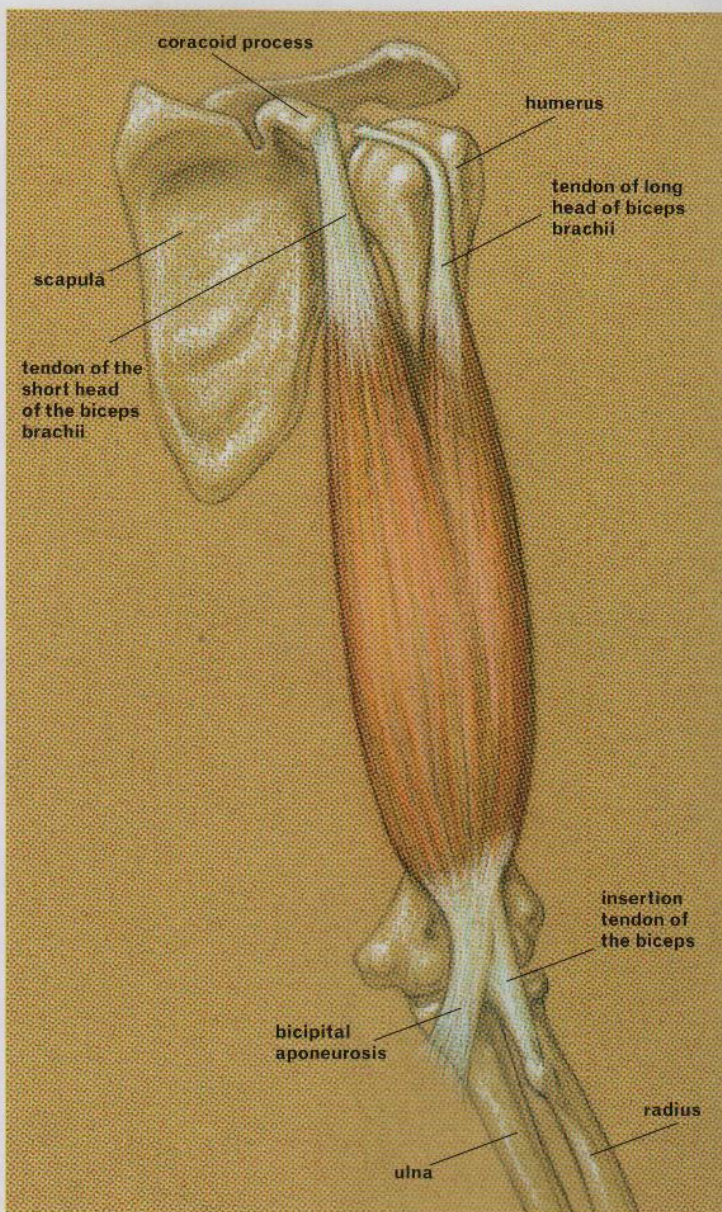
ORIGIN (LONG HEAD)
- supraglenoid tubercle of scapula (above glenoid fossa of scapula)

ORIGIN (SHORT HEAD)
- corocoid process of scapula

INSERTION
- radial tuberosity (radius bone)
- bicipital aponeurosis



BICEPS BRACHII—ACTION OF MUSCLE



BICEPS BRACHII (ANTERIOR VIEW, UPPER LEFT ARM)

Biceps Brachii

The biceps brachii is the two-headed muscle of the upper arm. Its two heads are the *long head* (syn: caput longum [TA]) and the *short head* (syn: caput breve [TA]).

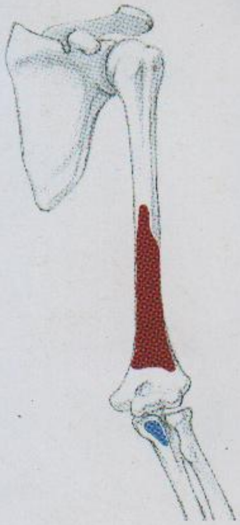
A fusiform muscle, the biceps brachii primarily occupies the entire anterior portion of the upper arm. The long head has a round, thin tendon that attaches right above the shallow socket (glenoid fossa) on the shoulder blade known as the *supraglenoid tubercle of the scapula*. The tendon travels across the head of the humerus and down along the anterior side of the upper arm bone in the trenchlike depression of the inter-tubercular groove (bicipital groove).

The short head of the biceps brachii has a flat, narrow tendon that attaches onto a fingerlike projection of bone on the shoulder blade called the *coracoid process of the scapula*. These tendons cannot be seen on the living model because they are covered by the deltoid muscle of the shoulder region. The two heads of the biceps brachii descend into two cylindrical bellies that merge into one large fleshy form about midway down the upper arm. At the bottom of the muscle is a thick, ropelike tendon that inserts into a slight bump on the radius bone called the *radial tuberosity*. Another flatter, sheath-like tendinous band, called the *bicipital aponeurosis,* branches away to blend with the fascia that covers the forearm beneath the skin.

ACTION OF THE MUSCLE

The main action of the biceps brachii is the flexion of the elbow joint (the bending of the forearm toward the upper arm). It also supinates (rotates) the forearm at the elbow joint from a position of pronation, returning the radius bone back to the anatomical position.

The biceps brachii undergoes a pronounced change of shape as the arm changes position. When the arm is straight, the muscle is elongated and stretched. When the arm bends in the action of being flexed, the bicep muscle becomes very compact and compressed, creating a round, ball-like shape.



Brachialis

PRONOUNCIATION
BRAY-kee-al-iss
or
bray-kee-AA-liss

ORIGIN OF THE TERM
Latin *brachialis* = pertaining to the arm

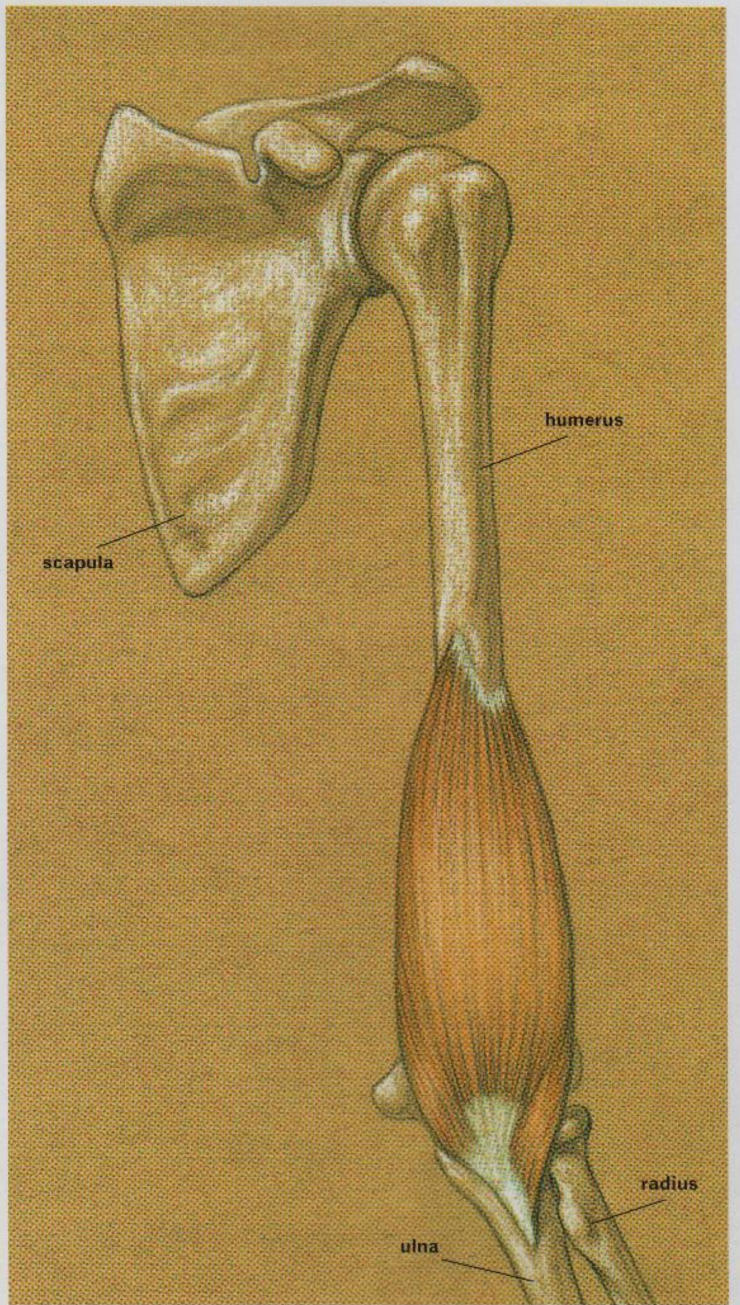
SYNONYMS
musculus brachialis (TA), brachialis anticus

BRACHIALIS—MUSCLE ATTACHMENTS

ORIGIN
■ lower front half of humerus

INSERTION
■ coronoid process of ulna

BRACHIALIS—ACTION OF MUSCLE
Flexion of elbow joint



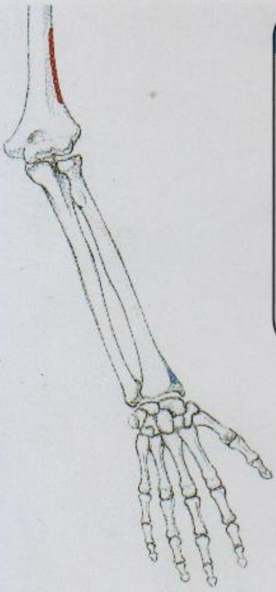
BRACHIALIS (ANTERIOR VIEW, UPPER LEFT ARM)

Brachialis

The brachialis muscle is a slightly flattened fusiform muscle that is mostly covered by the biceps brachii. A small portion can be seen on the surface of the arm, below the deltoid insertion and between the triceps, biceps, and brachioradialis muscles.

ACTION OF THE MUSCLE

The brachialis muscle has only one primary function: the flexion of the elbow joint. It lifts the ulna at the same time that the biceps brachii lifts the radius to produce the action of bending the forearm. During flexion, the muscle becomes rounder, creating a slight oval-shaped form on the outside surface of the upper arm next to the more prominent bulge of the lateral triceps head.



Brachioradialis

PRONOUNCIATION
BRAY-kee-oh-ray-dee-AL-iss
or
bray-kee-oh-ray-dee-AA-liss

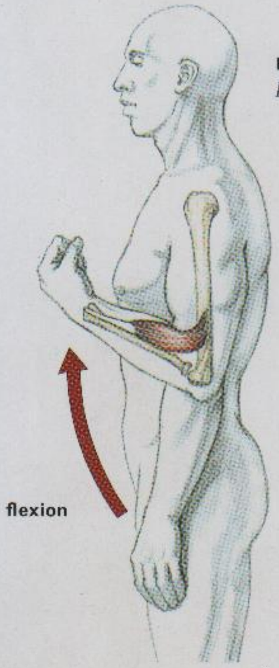
ORIGIN OF THE TERM
Latin *brachium* = arm +
radialis = pertaining to the radius bone

SYNONYMS
musculus brachioradialis (TA),
supinator longus, supinator radii longus,
long supinator

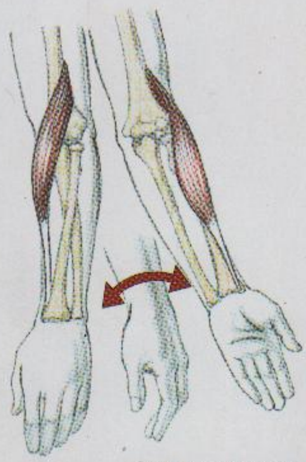
BRACHIORADIALIS—MUSCLE ATTACHMENTS

ORIGIN
■ humerus (lateral side, upper two-thirds)

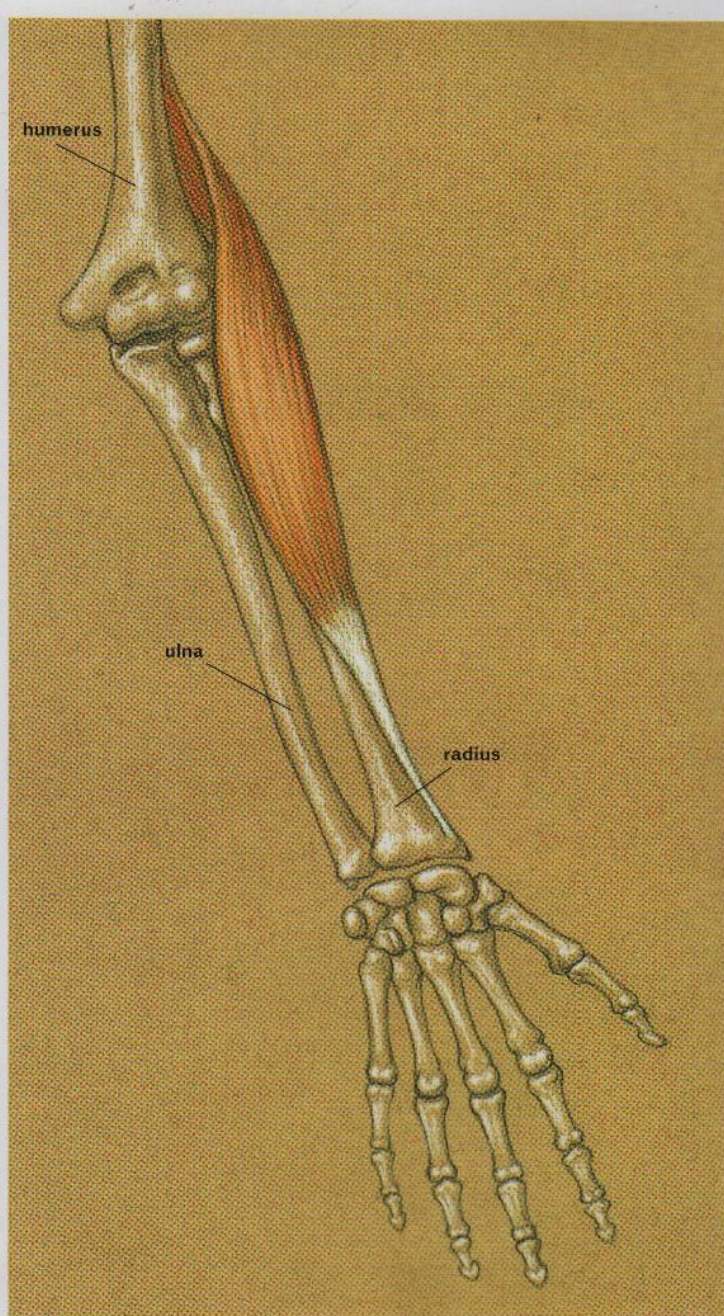
INSERTION
■ styloid process of radius



BRACHIORADIALUS—ACTION OF MUSCLE
Flexion of elbow joint



Assists in pronation and supination



BRACHIORADIALUS (ANTERIOR VIEW, UPPER AND LOWER LEFT ARM)

Brachioradialis

The brachioradialis is a prominent muscle that begins on the outer humerus and spirals downward toward the thumb side of the wrist. Its origin is on the lateral side of the humerus, between the triceps and brachialis muscles. About midway down the lower arm, the rich muscle fibers of the brachioradialis merge into a long, flat tendon, which attaches into the *styloid process of the radius* on the lateral (outer) side. When the arm moves from the anatomical position to a position of pronation (with the hand turning inward or toward the back), the brachioradialis assumes a spiraling form and becomes more noticeable on the surface.

In some anatomy books the brachioradialis is classified with the muscles of the lower arm rather than the upper arm because this muscle's fibers mostly occupy this region. (And it is sometimes classified as belonging to a separate group of muscles called the radial group; see page 181.)

ACTION OF THE MUSCLE

The main function of the brachioradialis is to assist in the flexion of the elbow joint (the bending of the forearm). An older name of brachioradialis is the *supinator longus,* which means that it helps supinate the lower arm. The muscle, however, also moves the radius bone into a position midway between supination and pronation, thus aiding in both these movements. Its action is evident in the repeated back-and-forth pronation and supination movements of the lower arm and hand when a person uses a screwdriver or a corkscrew.

Triceps Brachii

PRONOUNCIATION
TRI-seps BRAY-kee-ee
or
TRI-seps BRAKE-ee-eye

ORIGIN OF THE TERM
Latin *tri* = three + *caput* = head + *brachii* = of the arm

SYNONYMS
musculus triceps brachii (TA), triceps extensor cubitus, triceps

Anconeus

PRONOUNCIATION
an-KOH-nee-us

ORIGIN OF THE TERM
Greek *ankon* = elbow

SYNONYMS
musculus anconeus (TA), anconeus quartus

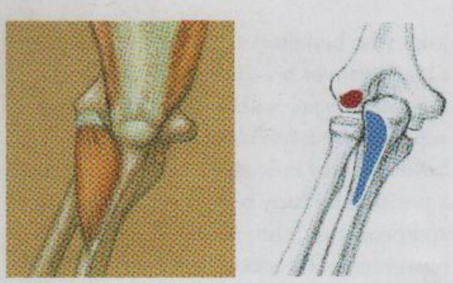
TRICEPS BRACHII—MUSCLE ATTACHMENTS

ORIGIN (LATERAL HEAD)
- humerus (posterior and lateral surface)

ORIGIN (MEDIAL HEAD)
- humerus (posterior and medial surface)

ORIGIN (LONG HEAD)
- infraglenoid tubercle of scapula (below glenoid fossa of scapula)

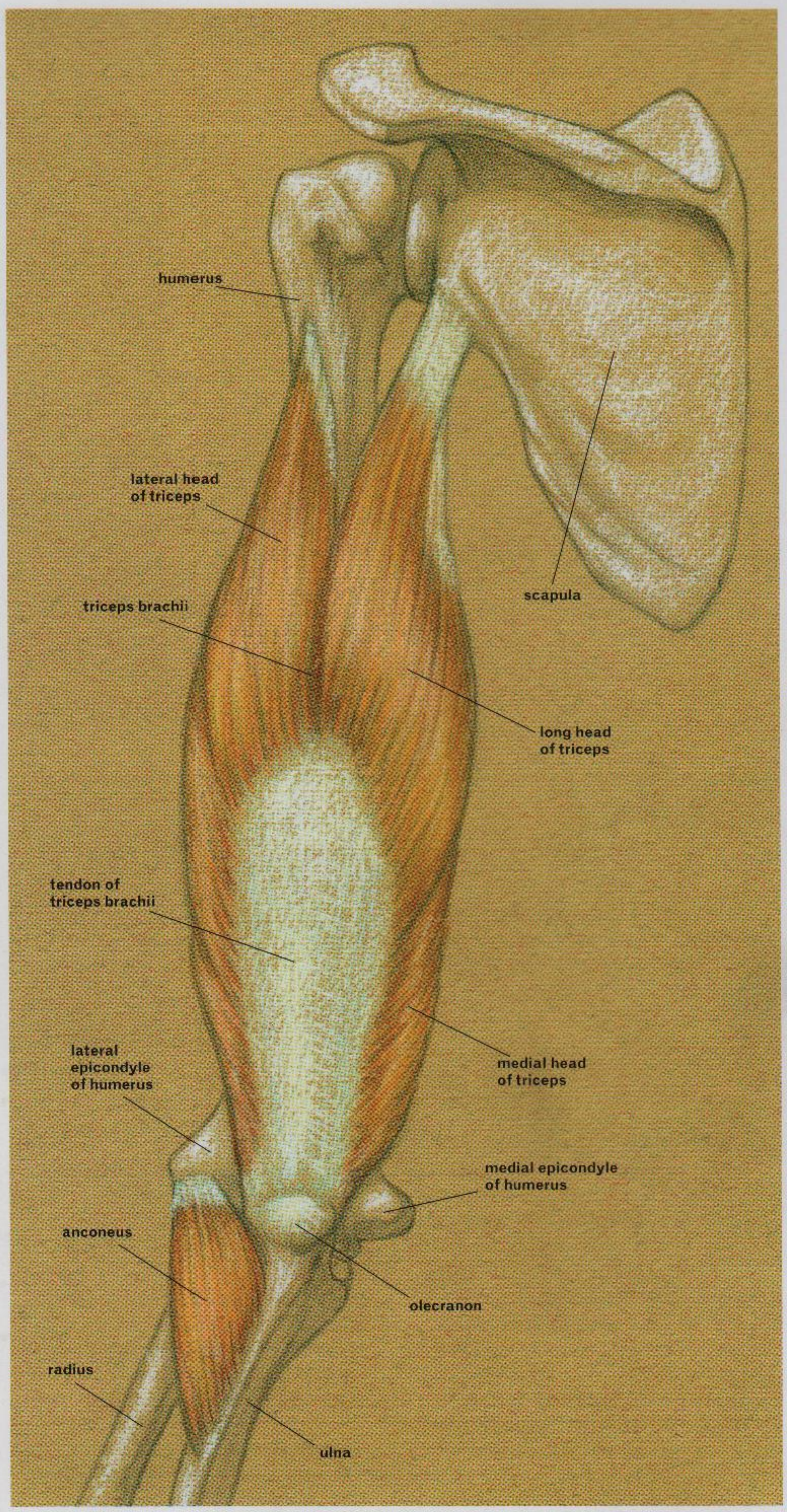
INSERTION
- by common tendon (triceps tendon) into olecranon process of ulna (elbow bone)



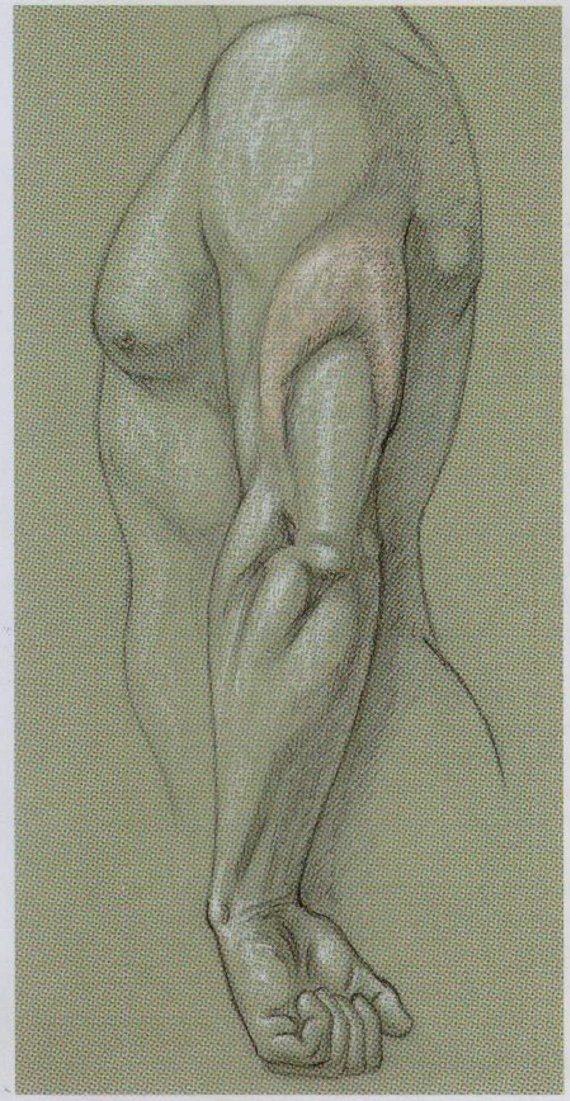
ANCONEUS—MUSCLE ATTACHMENTS

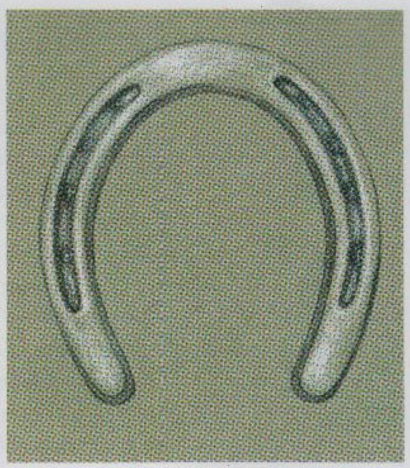
ORIGIN
- epicondyle of humerus (lateral and posterior surface)

INSERTION
- olecranon (elbow)
- ulna (upper fourth of posterior surface)

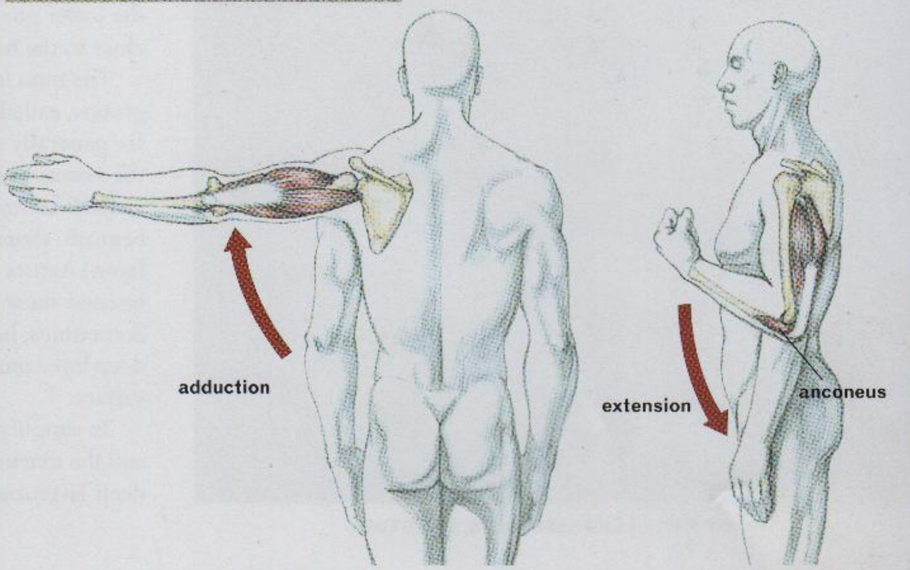


TRICEPS BRACHII AND ANCONEUS (POSTERIOR VIEW, UPPER AND PART OF LOWER LEFT ARM)





TRICEPS BRACHII—HORSESHOE SHAPE
When the triceps contracts on an arm with well-defined muscles (shown at far left), the three heads sometimes form a horseshoe shape (left) on the surface form.



TRICEPS BRACHII—ACTION OF MUSCLE
Left: Adduction of arm. Right: Extension of elbow joint.

Triceps Brachii and Anconeus

The triceps brachii is a three-headed muscle occupying the whole posterior aspect of the upper arm. It is a dynamic form because of the rich protruding bulges of the heads, which occur when the muscle is under tension.

The three heads are called the *lateral head, medial head,* and *long head*. The lateral head attaches on the outer and posterior portions of the humerus. The long head attaches on an area below the glenoid fossa (the socket of the shoulder blade) called the *infraglenoid tubercle of the scapula*. The medial head attaches on the inner and posterior portions of the humerus. It is mostly covered by the other two heads, but a small portion of its muscular fibers emerges on the lower third of the inside of the arm, below the long head. All three heads merge into a common flat tendon that inserts into the olecranon of the ulna (the elbow). The deltoid covers the extreme upper portion of the triceps.

When the triceps contracts, the heads become prominent bulges on the surface form. If the triceps are extremely developed, as on bodybuilders' arms, the bulges of the triceps' heads form a rich semicircular ring of muscular form around the neutral area of the triceps tendon. Bodybuilders refer to this as the horseshoe of the triceps.

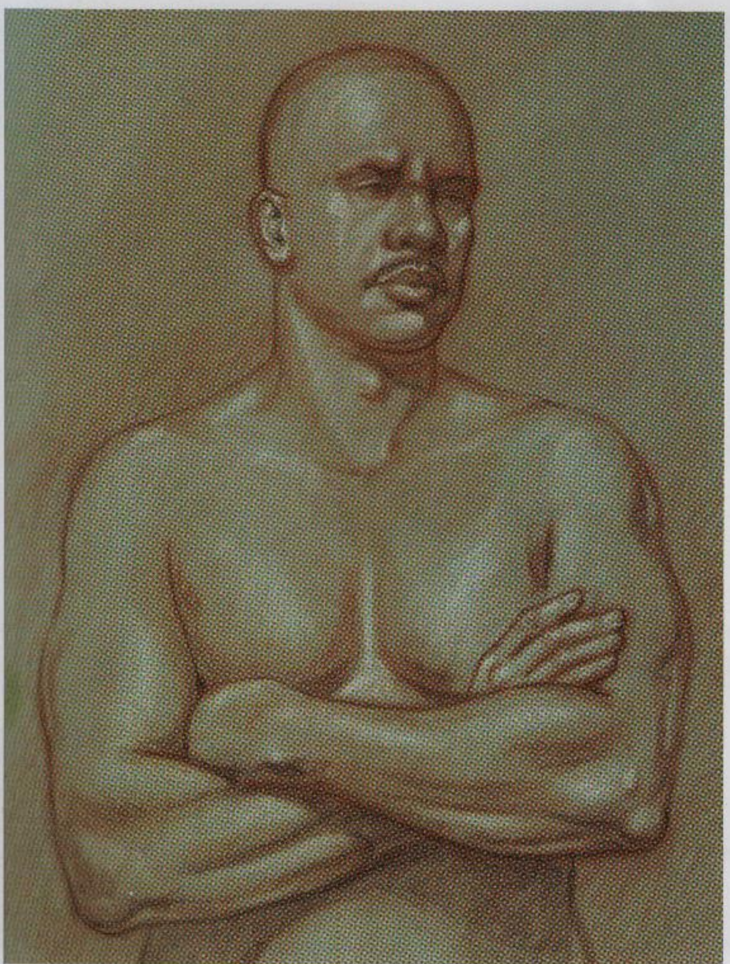
When the contracted triceps is viewed from the back, an angle occurs in which the lateral head is slightly higher up than the long head.

When the triceps is relaxed (or not well developed), the whole posterior side of the upper arm will register as a cylindrical shape with no indication of bulges from the triceps heads.

The anconeus muscle is a small, triangular muscle positioned near the olecranon (elbow). When the arm is extended (straightened), it is visible as a small fleshy mass between the so-called radial group (brachioradialis and extensor carpi radialis longus) and the elbow bone. The anconeus is attached on the posterior side of the lateral (outer) epicondyle of the humerus and inserts into the upper quarter of the ulna on the posterior surface.

ACTION OF THE MUSCLES

The triceps brachii's primary action is to extend (straighten) the forearm. It is the antagonist to the biceps brachii, which flexes (bends) the forearm. The long head also assists in adducting the whole arm and in helping stabilize the shoulder joint. When the lower arm is flexed, the heads of the triceps become more stretched and elongated. When the lower arm is straight, the heads contract, producing prominent forms on the back of the upper arm. The anconeus muscle assists the triceps in the extension of the forearm.



MAN WITH CROSSED ARMS, LIFE STUDY

Muscles of the Lower Arm

The muscles of the lower arm, or forearm, can be challenging to learn because their thin shapes look very much like each other. Also, when the lower arm rotates (in the movements of supination and pronation), the muscles spiral around the cylindrical form of the lower arm, making it difficult to figure out where each is located. And to complicate matters even further, many of these muscles' names are very similar and thus difficult to memorize.

The lower arm contains a series of mostly fusiform muscles with very elongated tendons that attach into the bones of the wrist and hand. This pattern gives the forearm its characteristic appearance, with the upper portion thicker and more curved and the lower portion more rectangular because the tendons ride so close to the bones.

The muscles of the lower arm are divided into two basic groups, called the *flexor group* and the *extensor group*. The groups are generally separated from one another by walls of fascia called the *intermuscular septa*. The groups are also divided into layers: a *superficial layer* that lies close to the surface and a *deep layer* beneath. (Some anatomists identify an intermediate, or middle, layer.) Artists are usually more interested in the superficial layer because these are the muscles that affect the surface forms. Sometimes, however, it is necessary to explore a few of the deep layer muscles because portions of their forms influence the surface.

To simplify matters, we will explore only the superficial layers and the extrinsic muscles of the thumb (which are considered deep-layer muscles).

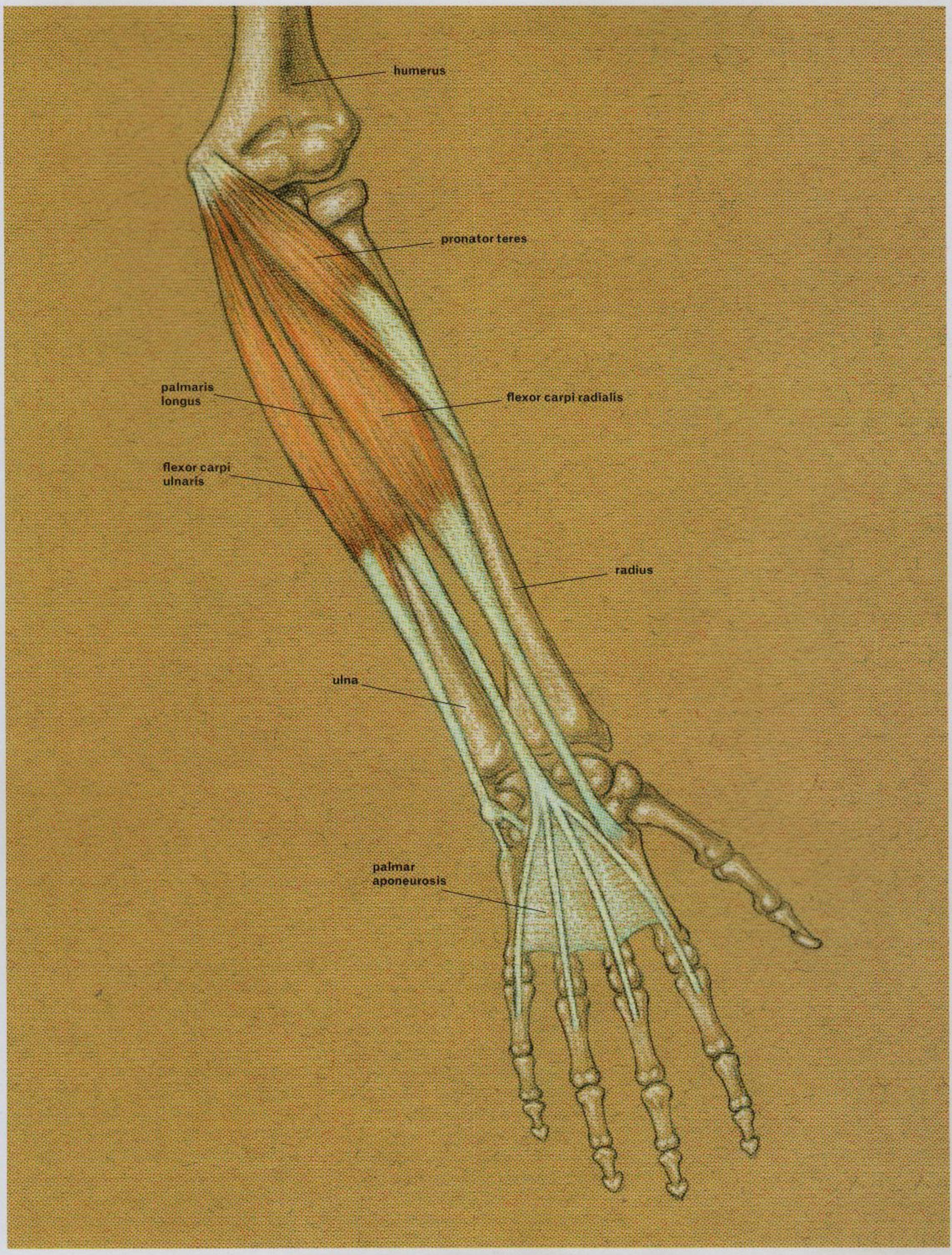
Flexor Group of the Lower Arm

To begin, observe the arm in the anatomical position—the view in which the palm is facing forward. The *anterior aspect of the arm* (sometimes referred to as the *anterior compartment of the arm*) is the location of the flexor muscle group. The muscles of the superficial layer of the flexor muscle group are the *flexor carpi ulnaris*, the *flexor carpi radialis*, the *palmaris longus*, and the *pronator teres*. All these muscles originate on the *medial epicondyle of the humerus* by way of a *common flexor tendon*. The point of attachment on the humerus is called the *common flexor origin*. The flexor muscles contribute to the flexion of the wrist joint and the flexion of the digits (fingers); one muscle assists in the movement of pronation of the lower arm.

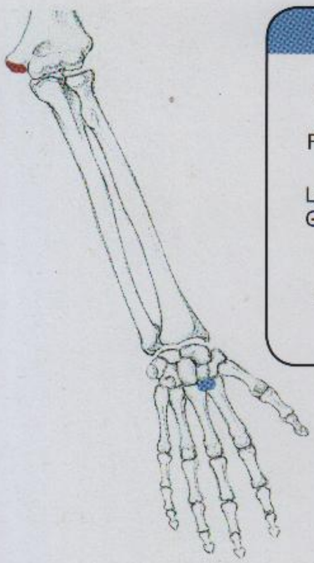
The *flexor retinaculum* is a fibrous band that connects to four carpal (wrist) bones on the palm side of the hand. It forms a tunnel (the carpal tunnel), through which the long tendons of the flexor muscles of the lower arm pass on their way into the hand.

NOTE ON TERMINOLOGY

Any muscle with the term *radialis* in its name is attached on or near the radius bone of the lower arm. Any muscle with the term *ulnaris* in its name is attached on or near the ulna bone of the lower arm.



FLEXOR GROUP OF LOWER ARM (ANTERIOR VIEW, LEFT ARM)



Flexor Carpi Radialis

PRONOUNCIATION

FLEK-sor KAR-pea ray-dee-AL-iss
or
FLEK-sor KARP-eye RAY-dee-ah-liss

ORIGIN OF THE TERM

Latin *flectere* = to bend + *carpus,* from Greek *karpos* = wrist + Latin *radialis* = pertaining to the radius bone

SYNONYMS

musculus flexor carpi radialis (TA), musculus radialis internus, FCR

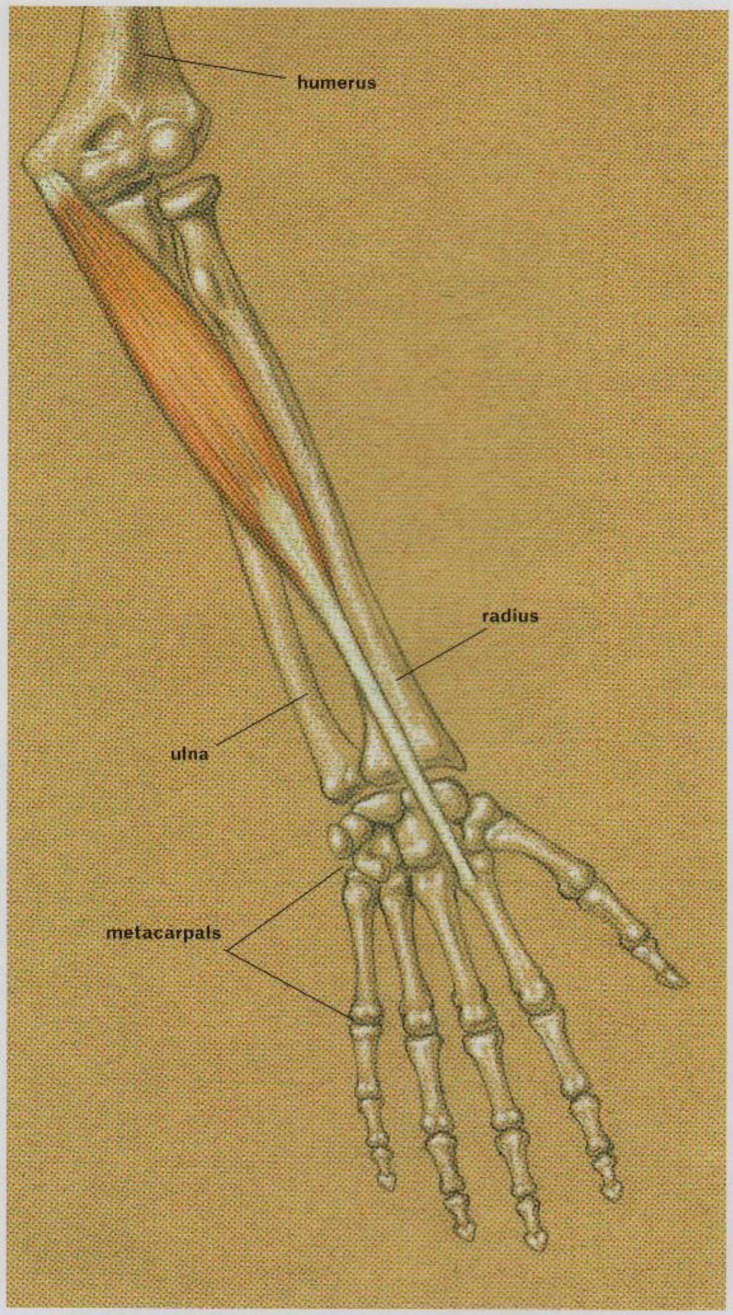
FLEXOR CARPI RADIALIS—MUSCLE ATTACHMENTS

ORIGIN

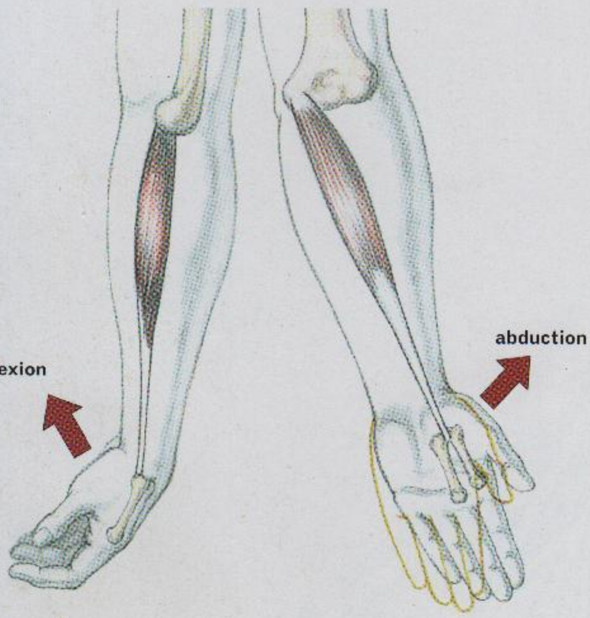
- medial epicondyle of humerus (common flexor origin)

INSERTION

- base of second metacarpal (palmar surface)
- base of third metacarpal (palmar surface)



FLEXOR CARPI RADIALIS (ANTERIOR VIEW, LOWER LEFT ARM)



FLEXOR CARPI RADIALIS—ACTION OF MUSCLE

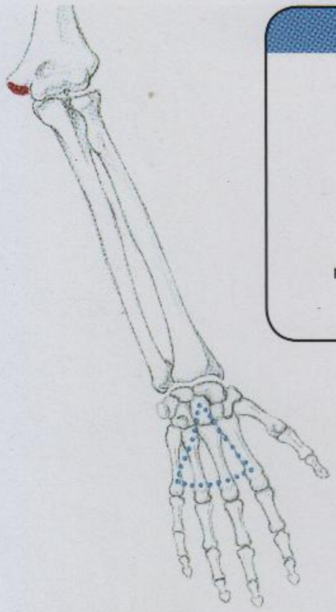
Left: Flexion of hand at wrist (lateral view, lower left arm). Right: Abduction of hand at wrist (anterior view, lower left arm).

Flexor Carpi Radialis

The flexor carpi radialis, or FCR, begins on the medial epicondyle and descends obliquely down the anterior side of the forearm. About midway down the lower arm, the muscle's fibers are replaced by a flat tendon, which eventually tapers to a narrower, cylindrical shape. The tendon passes beneath the flexor retinaculum to insert in the metacarpal bones of the index and middle fingers. The tendon is positioned slightly off the midpoint of the wrist, on the radial side of the arm. When the flexor carpi radialis tenses, the tendon is so prominent that it lifts the skin up against its cordlike shape. This muscle, along with the palmaris longus and the flexor extensor ulnaris, helps give the upper half of the inner forearm its rounded character.

ACTION OF THE MUSCLE

The flexor carpi radialis is a strong flexor of the wrist, bending the hand toward the inner lower arm. The muscle also assists the extensor carpi radialis longus and extensor carpi radialis brevis muscles in the abduction of the hand from the wrist joint (radial abduction)—the action of leaning the hand sideways from the wrist on the radial side of the arm.



Palmaris Longus

PRONOUNCIATION
pahl-MAR-iss LON-gus
or
pahl-MAH-riss LON-gus

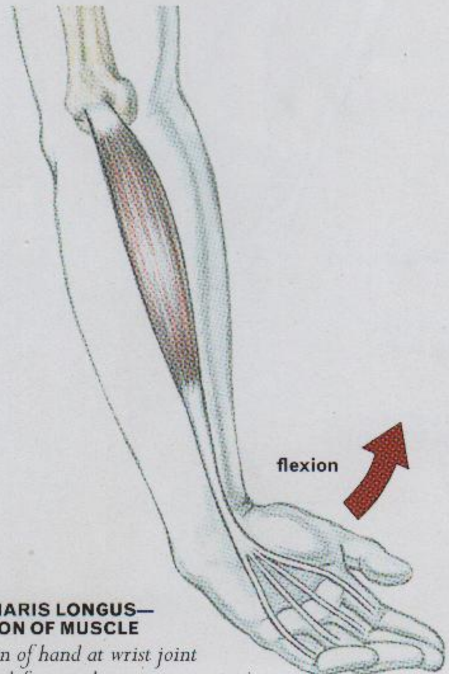
ORIGIN OF THE TERM
Latin *palma* = palm of hand +
longus = long

SYNONYMS
musculus palmaris longus (TA),
long palmar muscle

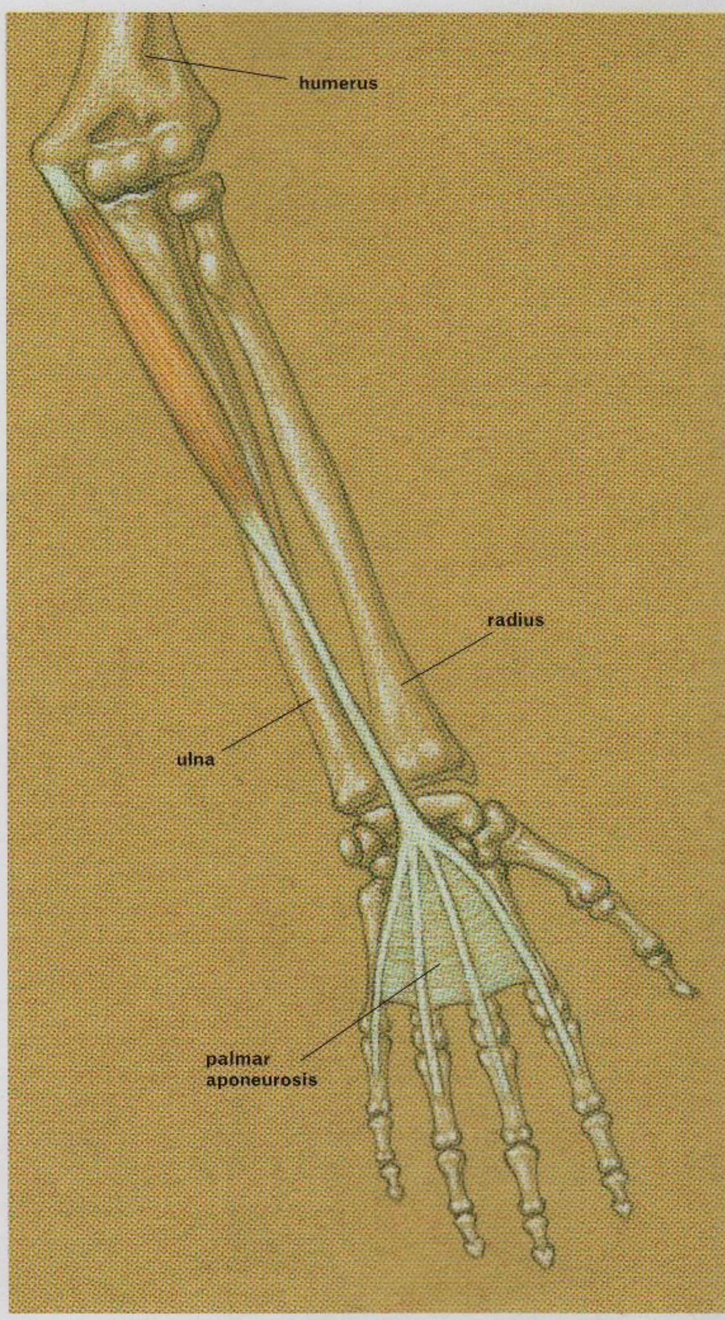
PALMARIS LONGUS—MUSCLE ATTACHMENTS

ORIGIN
- medial epicondyle of humerus (common flexor origin)

INSERTION
- flexor retinaculum
- palmar aponeurosis



PALMARIS LONGUS—ACTION OF MUSCLE
Flexion of hand at wrist joint (lower left arm, three-quarters view)



PALMARIS LONGUS (ANTERIOR VIEW, LOWER LEFT ARM)

Palmaris Longus

The palmaris longus is a rather thin muscle that lies between the thicker flexor carpi ulnaris and the flexor carpi radialis. It has a very long tendon that descends vertically toward the middle of the wrist. This tendon passes into the hand to attach into the flexor retinaculum and the palmar aponeurosis (a connective tissue that connects with the skin of the palm). It is noteworthy that this particular muscle is absent in some individuals.

ACTION OF THE MUSCLE

The palmaris longus flexes the wrist joint, bending the hand toward the inner lower arm. Also, because of its insertion into the fascia of the palm, it tenses or tightens the palmar aponeurosis and skin during certain hand movements.

Flexor Carpi Ulnaris

PRONOUNCIATION
FLEK-sor KAR-pea ull-NAY-riss
or
FLEK-sor KARP-eye ull-NAY-riss

ORIGIN OF THE TERM
Latin *flectere* = to bend + Latin *carpus*, from Greek *karpos* = wrist + Latin *ulnaris* = pertaining to the ulna bone

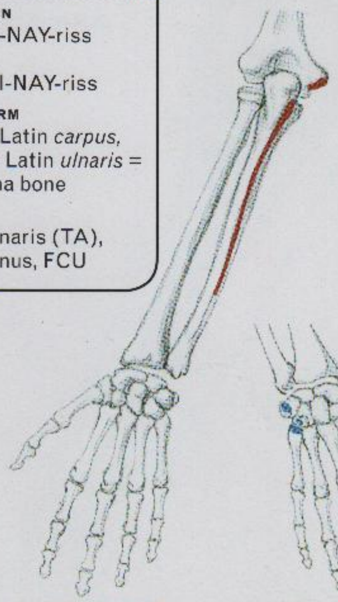
SYNONYMS
musculus flexor carpi ulnaris (TA), musculus ulnaris internus, FCU

FLEXOR CARPI ULNARIS—MUSCLE ATTACHMENTS

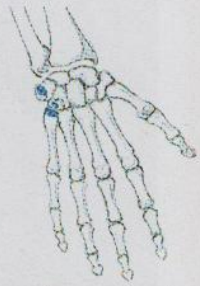
ORIGIN (HUMERAL HEAD)
- humerus (medial epicondyle) (common flexor origin)

ORIGIN (ULNAR HEAD)
- olecranon (medial border)
- ulna (upper two-thirds of posterior border)

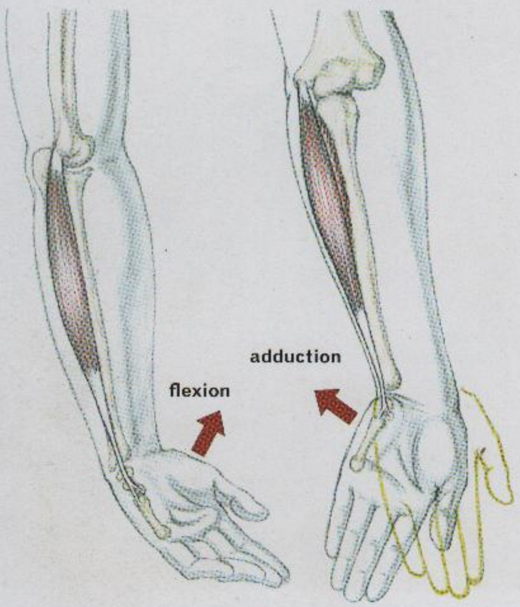
INSERTION
- pisiform (carpal bone)
- hook of hamate (carpal bone)
- base of fifth metacarpal



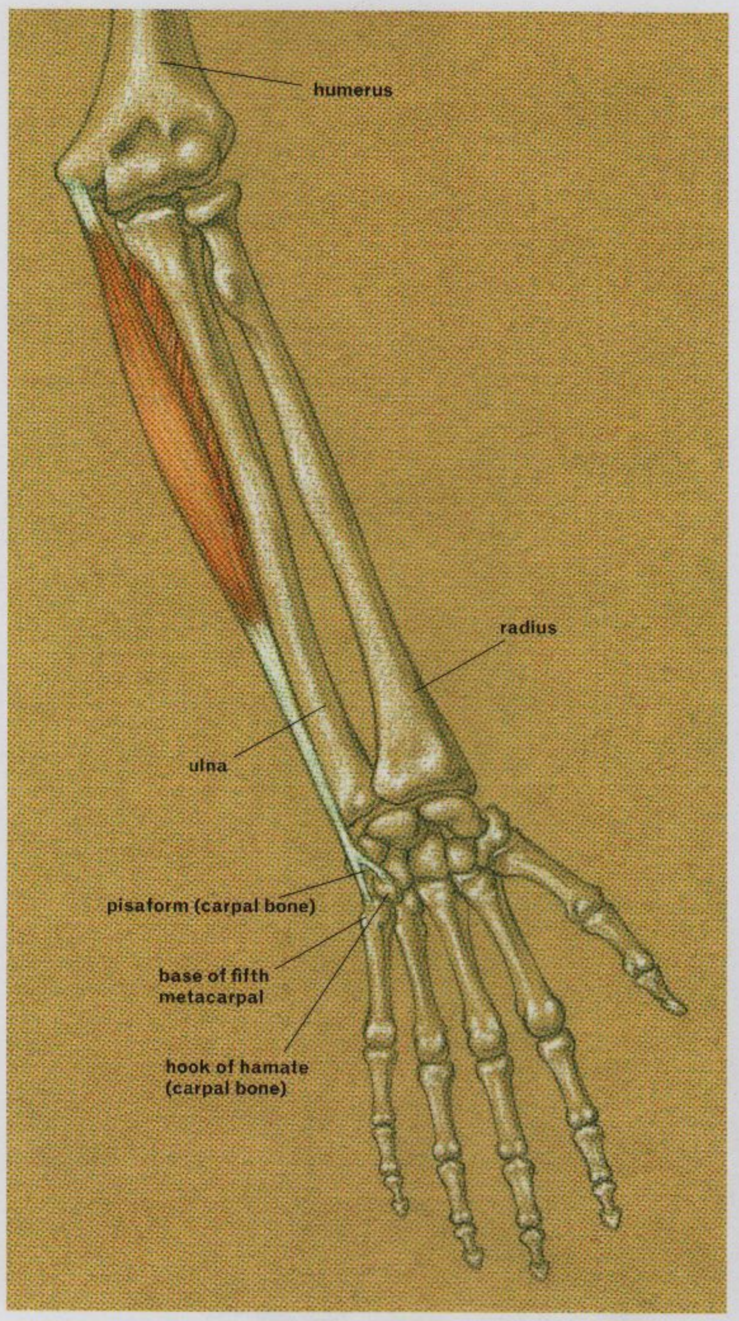
Posterior view of lower left arm



Anterior view of left hand



FLEXOR CARPI ULNARIS—ACTION OF MUSCLE
Left: Flexion of hand at wrist joint (anterior three-quarters view of lower left arm). Right: Adduction of hand at wrist joint (anterior view of lower left arm).



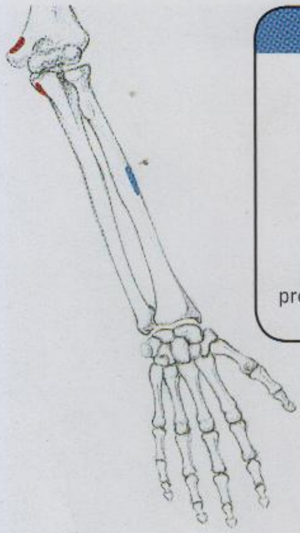
FLEXOR CARPI ULNARIS (ANTERIOR VIEW, LOWER LEFT ARM)

Flexor Carpi Ulnaris

The flexor carpi ulnaris, or FCU, attaches on the medial epicondyle of the humerus, from which its relatively large and bulky mass descends vertically along the ulna. The muscle contributes to the fleshy roundness of the whole inner border of the arm and is especially noticeable when the lower arm is pressed against the upper arm. The tendon of the flexor carpi ulnaris, which is not too prominent on the surface form, inserts into the *pisaform* carpal bone. From there, two ligaments continue the insertion by connecting into the *hook of the hamate* carpal bone and the base of the *fifth metacarpal* bone.

ACTION OF THE MUSCLE

Acting with the flexor carpi radialis, the flexor carpi ulnaris muscle flexes the wrist, bending the hand toward the inner arm. In conjunction with the extensor carpi ulnaris, the muscle also adducts the hand at the wrist joint (ulnar adduction)—the action of leaning the hand sideways toward the ulnar side of the arm.



Pronator Teres

PRONOUNCIATION
PRO-nay-torTEH-reez
or
pro-NAY-torTEH-reez

ORIGIN OF THE TERM
Latin *pronare* = to turn downward + *teres* = rounded

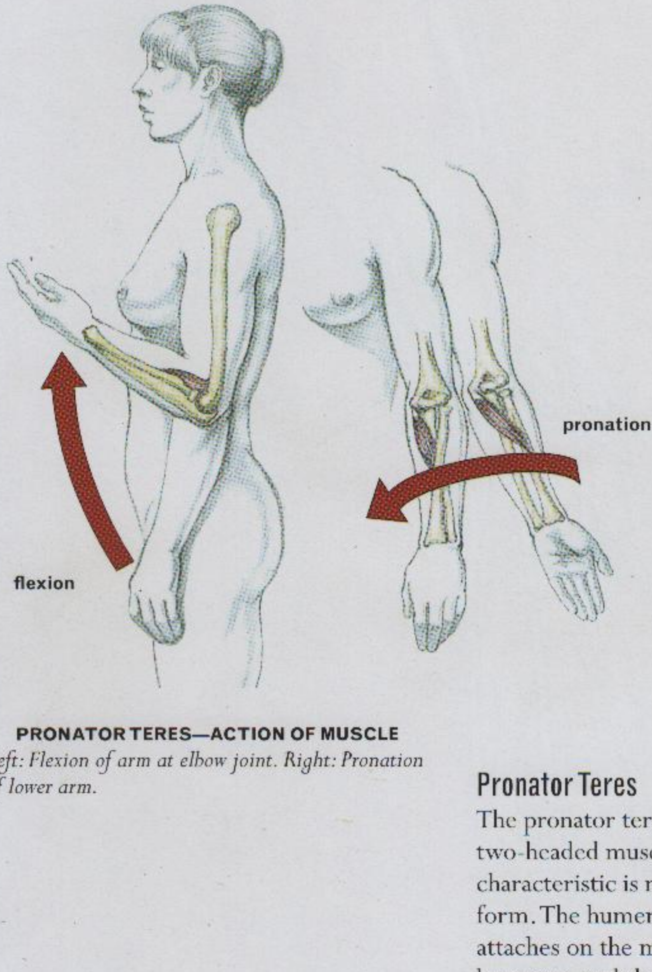
SYNONYMS
musculus pronator teres (TA), pronator radii teres, round rotator muscle

PRONATOR TERES—MUSCLE ATTACHMENTS

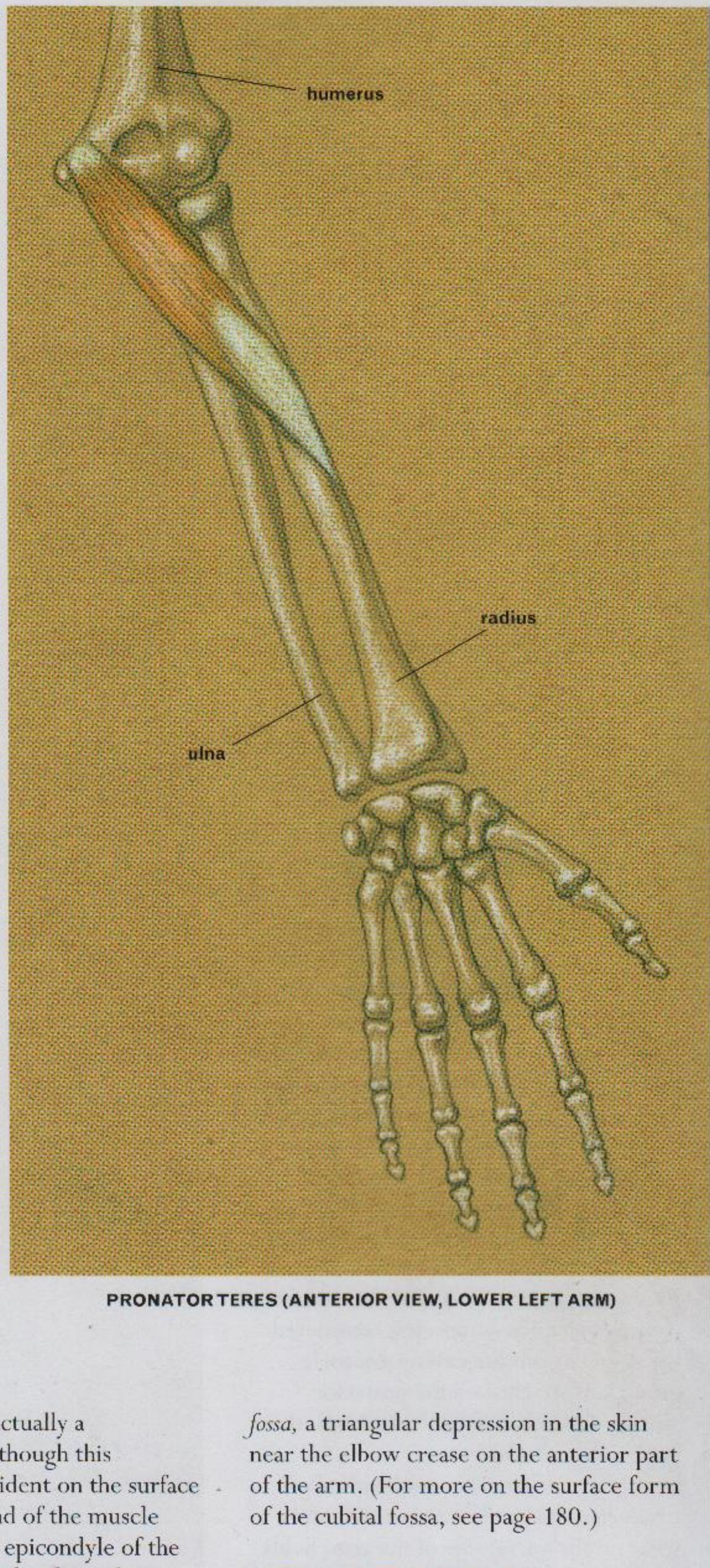
ORIGIN (HUMERAL HEAD)
- humerus (medial epicondyle) (common flexor origin)

ORIGIN (ULNAR HEAD)
- medial side of coronoid process of ulna

INSERTION
- radius (lateral surface) by common tendon



PRONATOR TERES—ACTION OF MUSCLE
Left: Flexion of arm at elbow joint. Right: Pronation of lower arm.



PRONATOR TERES (ANTERIOR VIEW, LOWER LEFT ARM)

Pronator Teres

The pronator teres is actually a two-headed muscle, although this characteristic is not evident on the surface form. The humeral head of the muscle attaches on the medial epicondyle of the humerus, and the ulnar head attaches on the medial side of the coronoid process of the ulna. As it descends, the pronator teres, which is shorter than the other flexor muscles of the lower arm, begins to cross obliquely toward the lateral side of the radius bone where it inserts. At this point, the brachioradialis partially covers the pronator teres. The pronator teres forms the medial border of the *cubital fossa,* a triangular depression in the skin near the elbow crease on the anterior part of the arm. (For more on the surface form of the cubital fossa, see page 180.)

ACTION OF THE MUSCLE

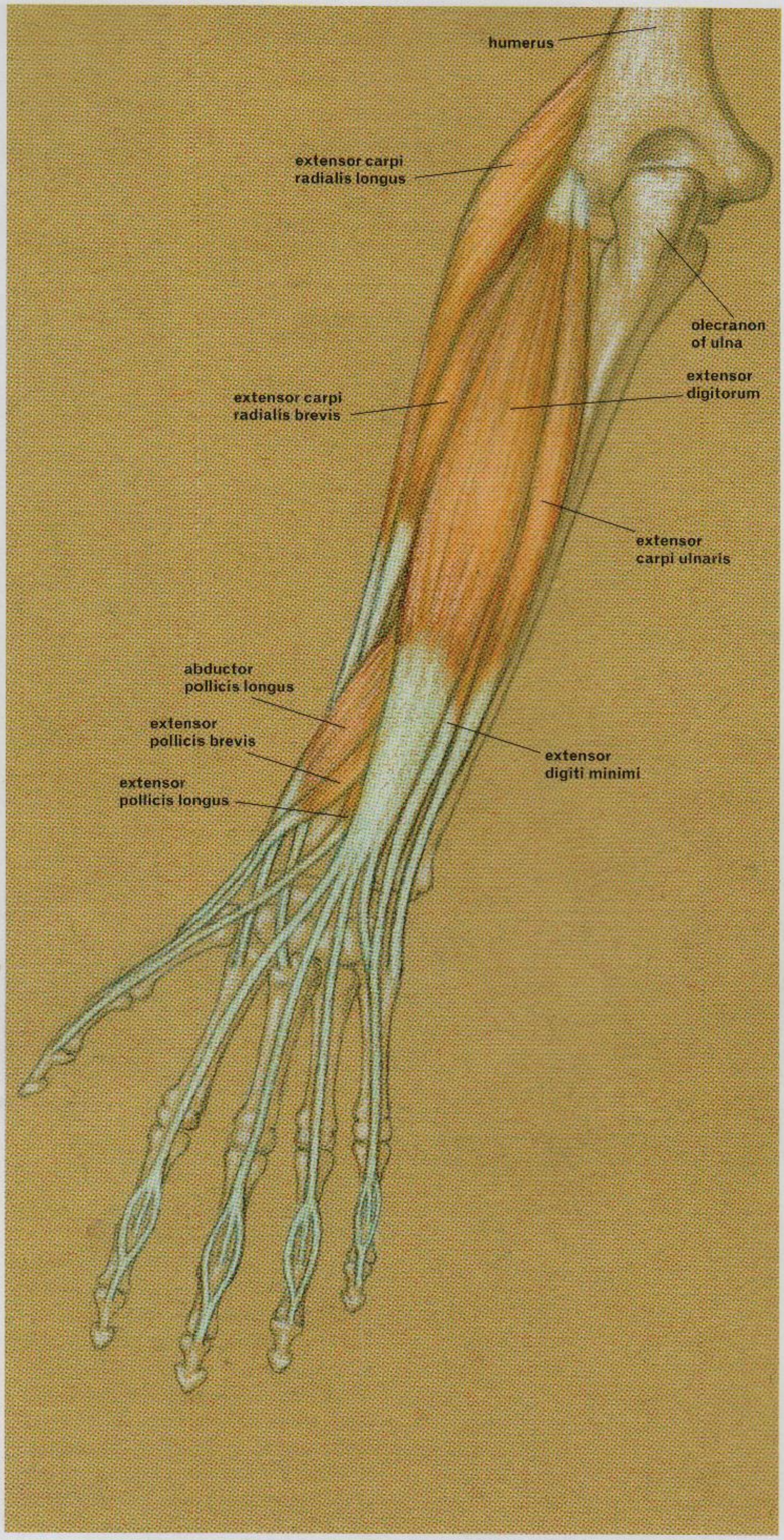
The pronator teres is the main pronator of the lower arm, playing the major role in the action of turning the palm of the hand backward, if the upper and lower arm is in an anatomical position, or downward, if the elbow of the lower arm is flexed (bent). The muscle also assists in the flexing of the elbow joint.

Extensor Group of the Lower Arm

The extensor muscle group is located on the *posterior aspect of the arm* (also referred to as the *posterior compartment of the arm*). In the anatomical position of the whole arm, this is the view in which the back of the hand is facing forward. The extensor muscles of the superficial layer are the *extensor carpi radialis longus,* the *extensor carpi radialis brevis,* the *extensor digitorum* (with the *extensor digiti minimi*), and the *extensor carpi ulnaris.* With the exception of the extensor carpi radialis longus, these muscles originate in the lateral epicondyle of the humerus by way of a *common extensor tendon.* The point of attachment on the humerus is called the *common extensor origin.* The muscles of the extensor group help extend, or straighten, the fingers and wrist from a flexed, or bent, position.

Beneath the superficial layer of the extensor group are the extrinsic muscles of the thumb: the *abductor pollicis longus,* the *extensor pollicis brevis,* and the *extensor pollicis longus.* These muscles, considered the deep layer of the extensor muscle group, are attached on the posterior aspect of the forearm and insert into the bones of the thumb.

A bracelet-like ligament band called the *extensor retinaculum,* connected at the wrist on the dorsal side of the arm, holds the tendons of the extensor muscles in place and close to the carpal bones. The extensor retinaculum prevents the tendons from "bow-stringing"—jumping outward when the hand is bending back at the wrist in hyperextension. Also, the tendons of these muscles are encased in *synovial sheaths,* which minimize friction when the tendons slide against each other.



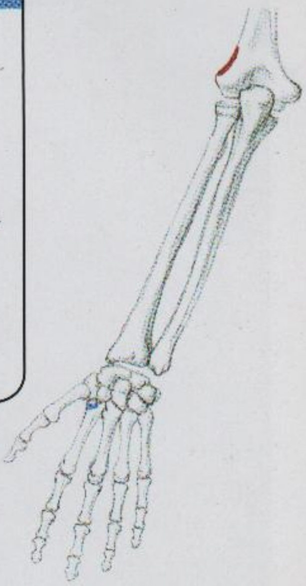
EXTENSOR GROUP OF LOWER ARM (POSTERIOR VIEW, LOWER LEFT ARM)
With the deep-layer thumb muscle group

Extensor Carpi Radialis Longus

PRONOUNCIATION
ek-STEN-sor KAR-pea
ray-dee-AA-liss LON-gus
or
ek-STEN-sor KARP-eye
RAY-dee-ah-liss LON-gus

ORIGIN OF THE TERM
Latin *extendere* = to stretch out +
Latin *carpus*, from Greek *karpos* = wrist +
Latin *radialis* = pertaining to the radius bone + *longus* = long

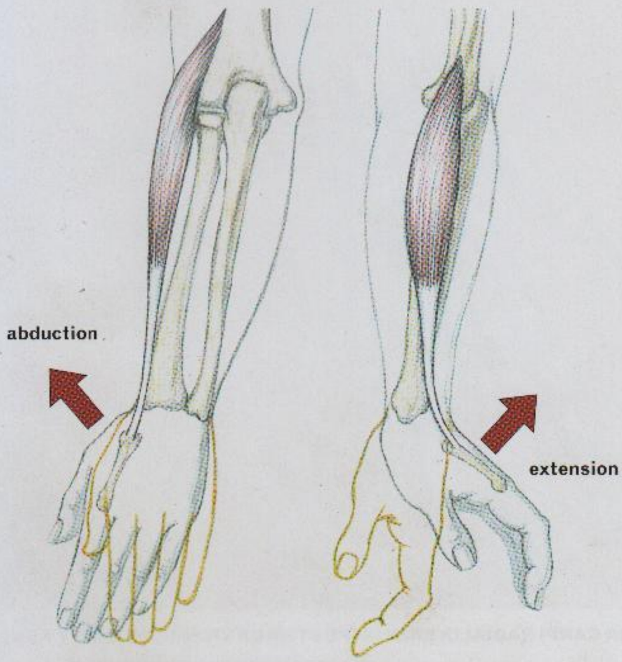
SYNONYMS
musculus extensor carpi radialis longus (TA), external carpi radialis longior, radialis externus longus, ECRL



EXTENSOR CARPI RADIALIS LONGUS—MUSCLE ATTACHMENTS

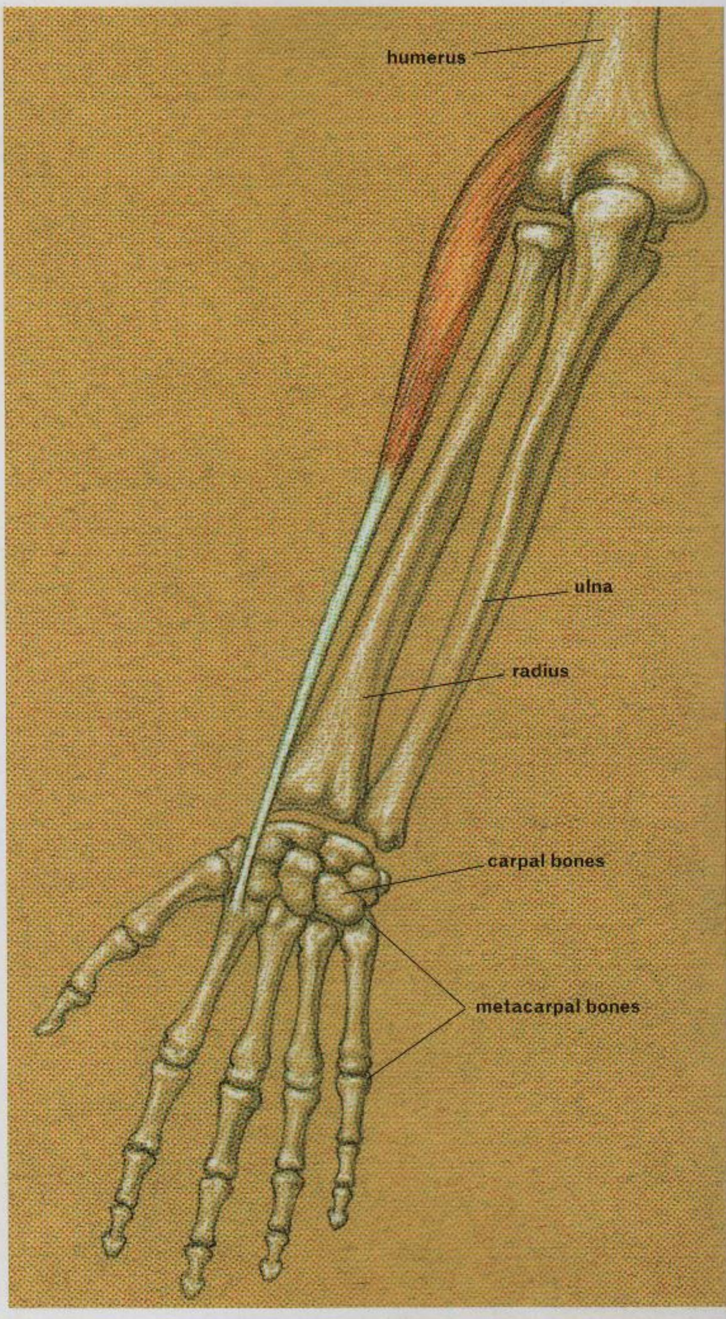
ORIGIN
■ lateral supracondylar ridge of the humerus

INSERTION
■ base of second metacarpal (dorsal surface)



EXTENSOR CARPI RADIALIS LONGUS—ACTION OF MUSCLE

Left: Abduction of hand at wrist joint (posterior view of lower left arm). Right: Extension of hand at wrist joint (lateral view of lower left arm).



EXTENSOR CARPI RADIALIS LONGUS (POSTERIOR VIEW, LOWER LEFT ARM)

Extensor Carpi Radialis Longus

The extensor carpi radialis longus, or ECRL, is an elongated fusiform muscle that is partly overlapped by the brachioradialis. These two muscles, which run parallel to one another, create the thick muscular form beginning on the outer part of the humerus, slightly above the elbow joint. They both spiral across the forearm toward the region of the thumb. Sometimes the two muscles are categorized as belonging to a separate group, called the *radial group,* because of the muscles' location along the radius bone. (For more on this group and the surface forms it creates, see page 181.)

ACTION OF THE MUSCLE

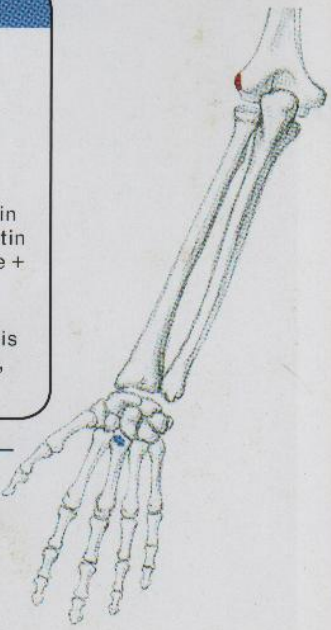
The main action of the extensor carpi radialis longus is the extension of the hand at the wrist joint, which it performs in conjunction with the extensor carpi ulnaris. With the flexor carpi radialis, it also abducts the hand at the wrist joint (radial abduction), leaning the hand sideways from the wrist on the radial side of the arm.

Extensor Carpi Radialis Brevis

PRONOUNCIATION
ek-STEN-sor KAR-pea
ray-dee-AA-liss BREH-viss
or
ek-STEN-sor KARP-eye
RAY-dee-ah-liss BREV-iss

ORIGIN OF THE TERM
Latin *extendere* = to stretch out + Latin *carpus,* from Greek *karpos* = wrist+ Latin *radialis* = pertaining to the radius bone + *brevis* = short

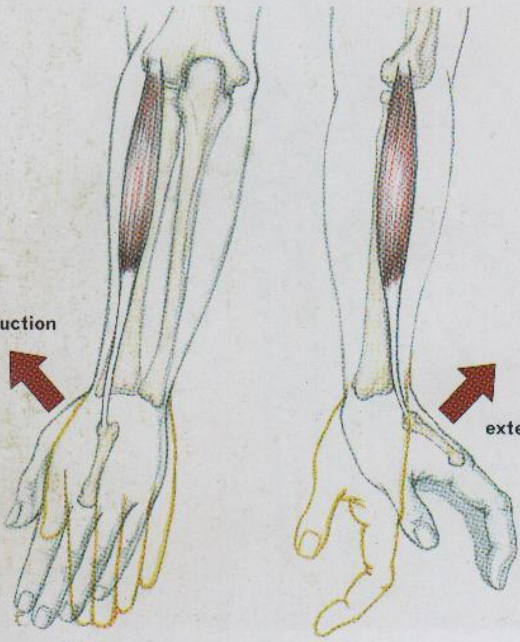
SYNONYMS
musculus extensor carpi radialis brevis (TA), extensor carpi radialis brevior, radialis externus brevis, ECRB



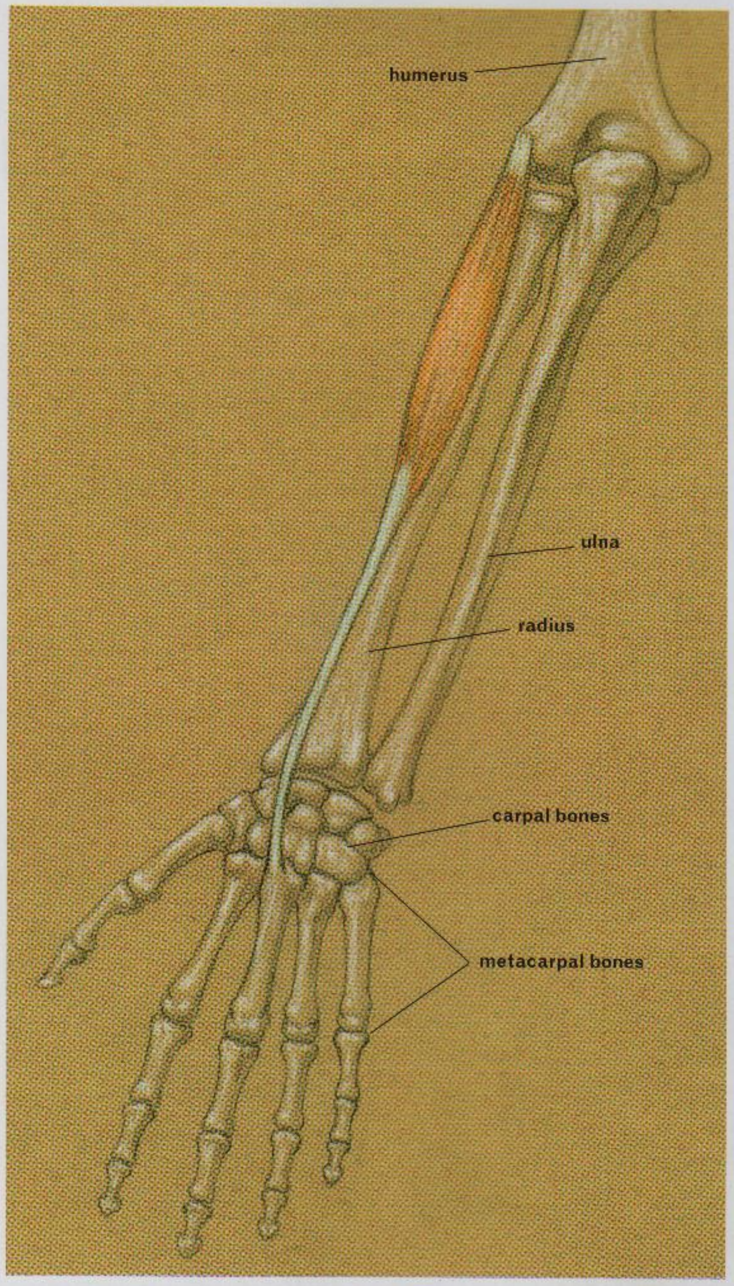
EXTENSOR CARPI RADIALIS BREVIS—MUSCLE ATTACHMENTS

ORIGIN
- lateral epicondyle of humerus (common extensor origin)

INSERTION
- base of third metacarpal (dorsal surface)



EXTENSOR CARPI RADIALIS BREVIS—ACTION OF MUSCLE
Left: Abduction of hand at wrist joint (posterior view of lower left arm). Right: Extension of hand at wrist joint (lateral view of lower left arm).



EXTENSOR CARPI RADIALIS BREVIS (POSTERIOR VIEW, LOWER LEFT ARM)

Extensor Carpi Radialis Brevis

The extensor carpi radialis brevis, or ECRB, attaches on the lateral epicondyle of the humerus. Its upper fibers are covered by the larger extensor carpi radialis longus muscle, but the ECRB then emerges to ride parallel with the ECRL down the radial side of the arm. The tendons of the two muscles travel down the arm side by side to where they insert into the second and third metacarpals.

ACTION OF THE MUSCLE

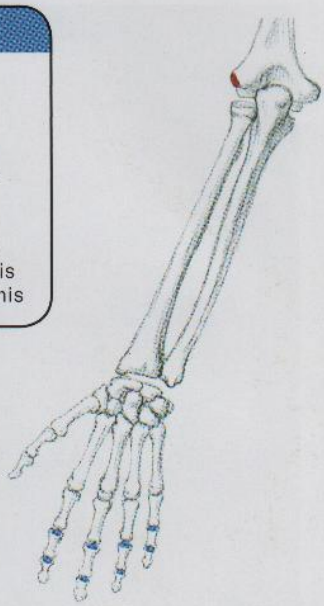
The extensor carpi radialis brevis extends (straightens) the hand at the wrist joint in conjunction with the extensor carpi ulnaris and extensor carpi radialis longus muscles. With the flexor carpi radialis, it also abducts the hand (radial abduction), leaning the hand sideways from the wrist toward the radial side of the arm.

Extensor Digitorum

PRONOUNCIATION
ek-STEN-sor dij-ih-TOR-um

ORIGIN OF THE TERM
Latin *extendere* = to stretch out + *digitorum* = pertaining to the digits (fingers)

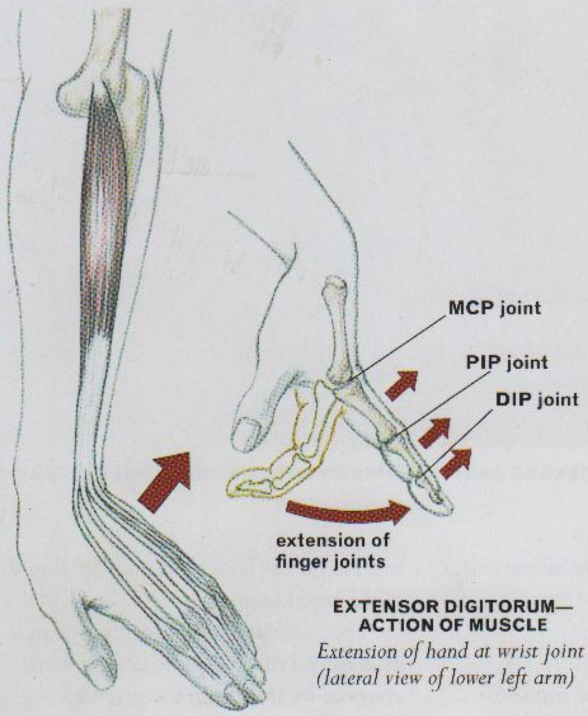
SYNONYMS
musculus extensor digitorum (TA), external digitorum, external communis digitorum, extensor digitorum communis



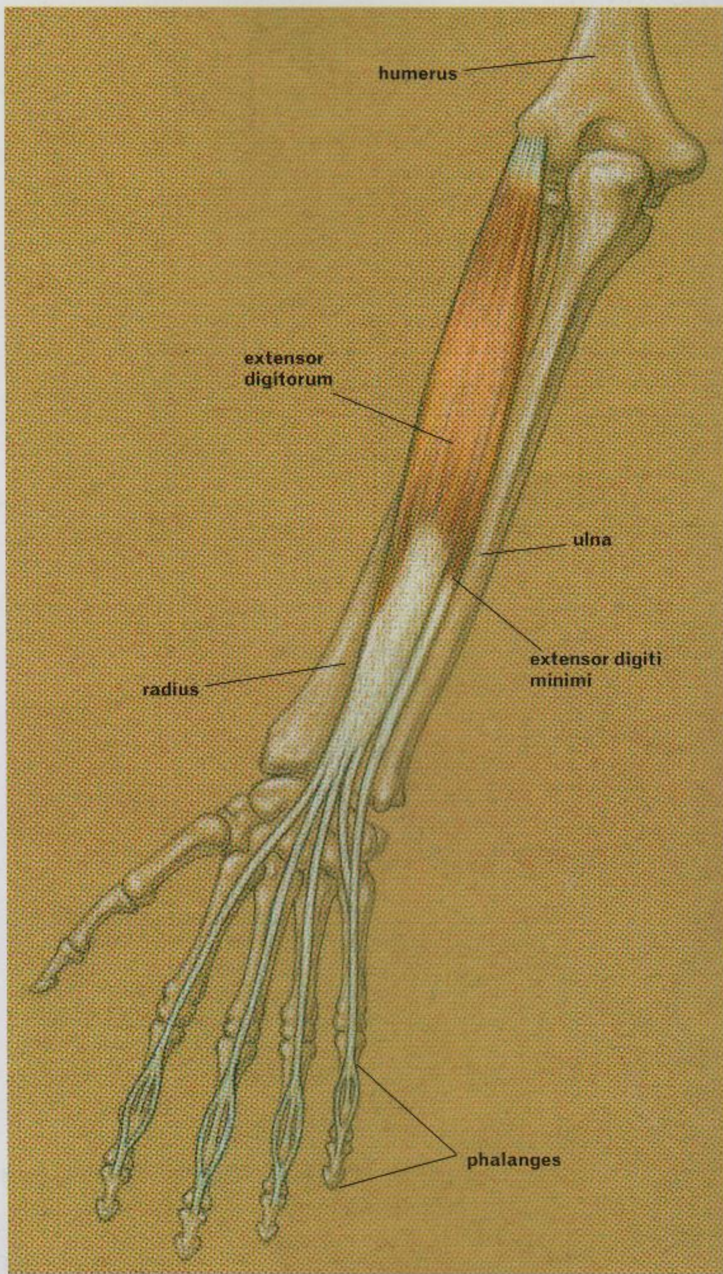
EXTENSOR DIGITORUM—MUSCLE ATTACHMENTS

ORIGIN
- lateral epicondyle of humerus (common extensor origin)

INSERTION
- bases of middle and distal phalanges of fingers 2, 3, 4, and 5 (via four tendons)



EXTENSOR DIGITORUM—ACTION OF MUSCLE
Extension of hand at wrist joint (lateral view of lower left arm)



EXTENSOR DIGITORUM (POSTERIOR VIEW, LOWER LEFT ARM)

Extensor Digitorum

The extensor digitorum lies medially to the extensor carpi radialis brevis and occupies much of the posterior surface of the lower arm. Its attachment is on the lateral epicondyle of the humerus at the common extensor origin. The muscle's elongated form can be more easily seen on muscular arms.

On the lower half of the forearm, the muscle is replaced by a broad tendon, which splits into four separate tendons near the wrist. These tendons pass under the extensor retinaculum to insert into each of the four fingers. As each tendon heads for its respective finger, it splits again, into three bands. The *central band* inserts on the bases of the proximal and middle phalanges, and the two *lateral bands* swing around on either side of the central band to reunite at the base of the distal phalanx.

A smaller, thinner muscle called the *extensor digiti minimi* is considered a detached portion of the extensor digitorum. This extensor of the little finger also originates at the lateral epicondyle of the humerus; its slender belly parallels the extensor digitorum, sometimes becoming separately visible on the surface form about a third of the way down the lower arm. Near the wrist, the tendon of the extensor digiti minimi heads toward the little finger, where it inserts.

ACTION OF THE MUSCLE

The extensor digitorum is the primary mover in the action of extension of the fingers from the metacarpo-phalangeal joints (MCP joints, or knuckles). The muscle also assists in moving the individual finger joints (the inter-phalangeal joints, or IP joints, which include both the PIP joint, or proximal inter-phalangeal [the joint closer to the wrist], and the DIP joint, or distal inter-phalangeal [the joint farther from the wrist]).

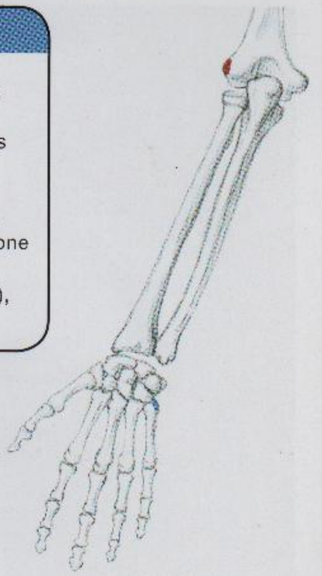
The extensor digitorum also contributes to the extension of the wrist, pulling the hand back from a flexed position. (This is sometimes referred to as hyperextension of the wrist.)

Extensor Carpi Ulnaris

PRONOUNCIATION
ek-STEN-sor KAR-pea ull-NAY-riss
or
ek-STEN-sor KARP-eye ull-NAY-riss

ORIGIN OF THE TERM
Latin *extendere* = to stretch out + *carpus*, from Greek *karpos* = wrist + Latin *ulnaris* = pertaining to the ulna bone

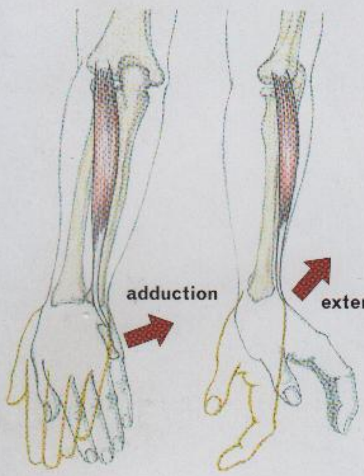
SYNONYMS
musculus extensor carpi ulnaris (TA), ulnaris externus, ECU



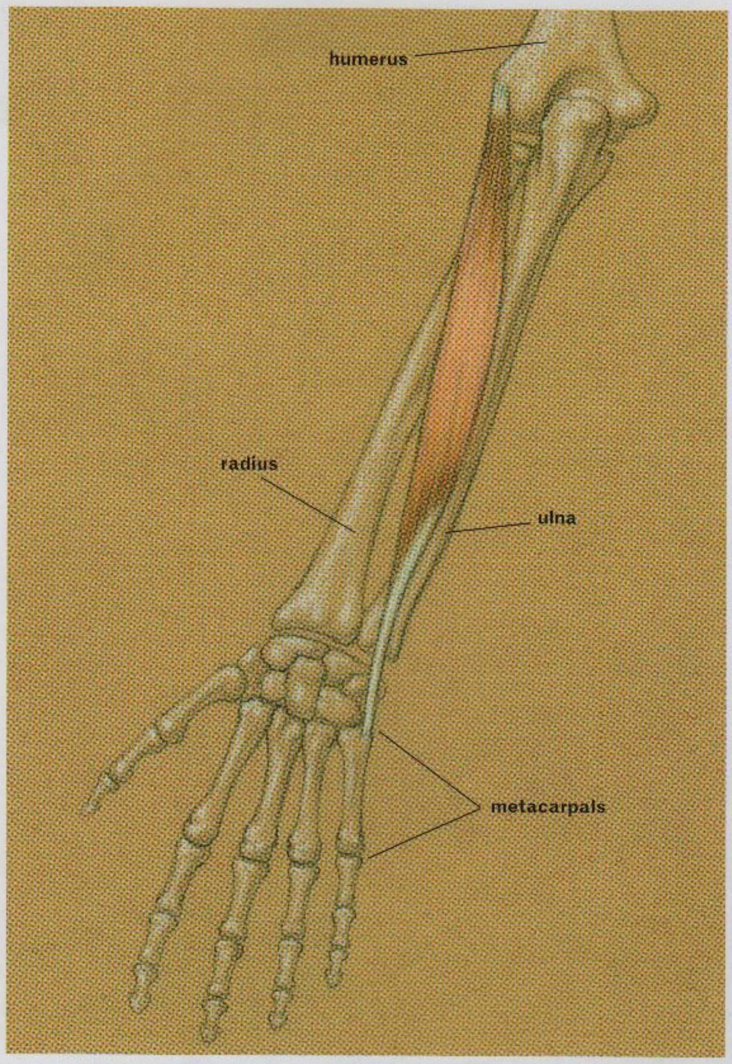
EXTENSOR CARPI ULNARIS—MUSCLE ATTACHMENTS

ORIGIN
- lateral epicondyle of humerus (common extensor origin)
- posterior border of ulna

INSERTION
- base of fifth metacarpal (dorsal surface)



EXTENSOR CARPI ULNARIS—ACTION OF MUSCLE
Left: Adduction of hand at wrist joint (posterior view of lower left arm). Right: Extension of hand at wrist joint (lateral view of lower left arm).



EXTENSOR CARPI ULNARIS (POSTERIOR VIEW, LOWER LEFT ARM)

Extensor Carpi Ulnaris

The extensor carpi ulnaris, or ECU, is a long fusiform muscle that is positioned mostly on the medial side of the forearm. It produces a narrow muscular ridge above the ulna furrow, which is the subcutaneous edge of the ulna bone. The flexor carpi ulnaris is positioned below the ulna furrow.

To avoid confusion concerning these very similar names, remember that the term *ulnaris* refers to structures on or near the ulna bone, along which both of these muscles are positioned; *extensor* refers to a muscle on the *posterior side* of the arm, while *flexor* refers to a muscle on the *anterior side* of the arm.

ACTION OF THE MUSCLE

The extensor carpi ulnaris, in conjunction with the extensor carpi radialis longus, extends the hand at the wrist joint. With the flexor carpi ulnaris, the muscle also adducts the hand at the wrist joint (ulnar adduction), leaning the hand sideways from the wrist joint toward the ulnar side of the arm.

Thumb Muscle Group

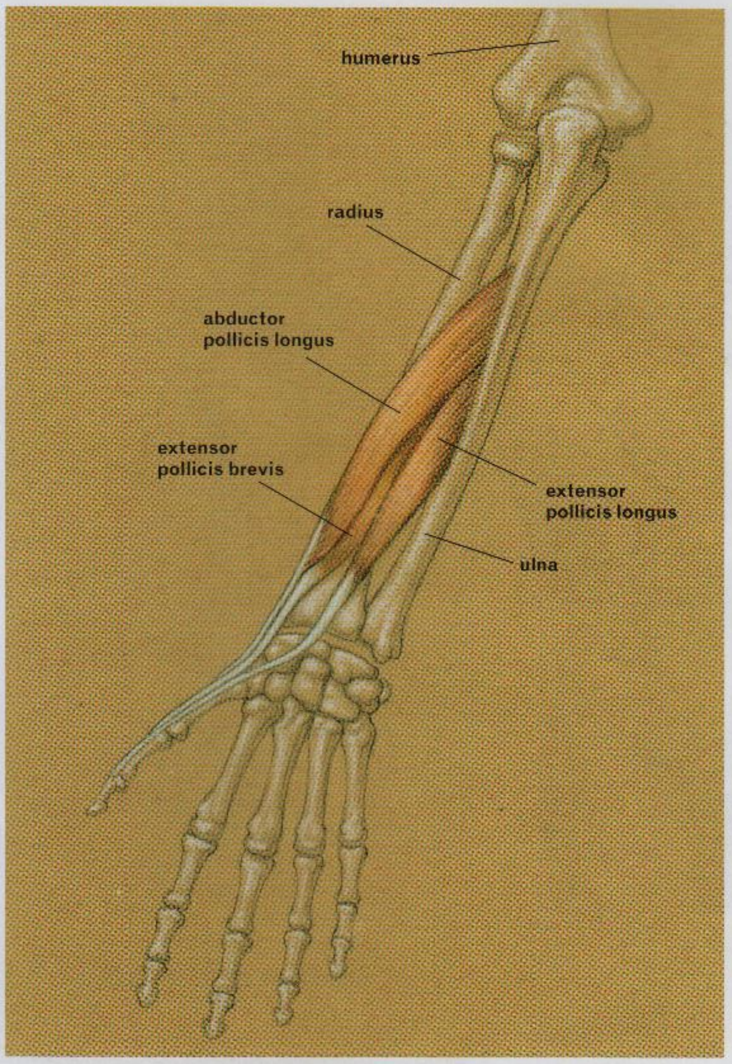
The deep layer of the extensor muscle group consists of the three extrinsic muscles of the thumb: the *abductor pollicis longus*, the *extensor pollicis brevis*, and the *extensor pollicis longus*. The three muscles attach on the dorsal side of the arm and travel obliquely downward toward the thumb. Their long tendons create a triangular hollow known as the *anatomical snuffbox* in the location of the thumb metacarpal. The "snuffbox" landmark can be seen when the thumb is extended, as in the action of thumbs-up. (For more on the surface form of the anatomical snuffbox, see page 181.)

The abductor pollicis longus attaches midway on the ulna and radius bones and emerges from between the extensor digitorum and the extensor carpi radialis brevis muscles. Its long tendon inserts on the lateral side of the thumb's metacarpal bone.

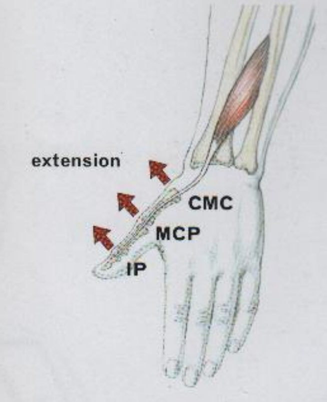
The extensor pollicis brevis muscle attaches to the radius bone and is partly covered by the abductor pollicis longus. Its tendon runs parallel to the tendon of the abductor pollicis longus to insert into the proximal phalanx of the thumb. These tendons together form the lateral side of the anatomical snuffbox.

The extensor pollicis longus is larger than the extensor pollicis brevis. It attaches on the ulna, and its long tendon travels toward the tubercle of the radius bone, where it abruptly changes direction, continuing downward toward the base of the distal phalanx of the thumb. The tendon of the extensor pollicis longus is considered the medial border of the anatomical snuffbox.

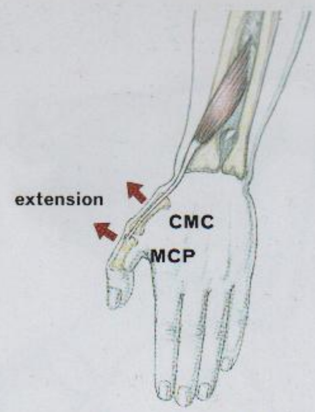
These muscles are generally covered by the superficial muscles, yet a small portion of their fleshy bellies will surface near the thumb side of the arm, creating a subtle



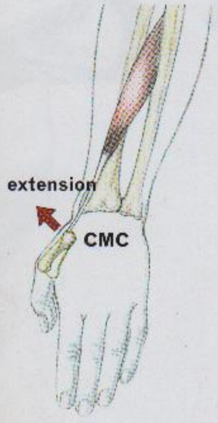
THUMB MUSCLE GROUP (POSTERIOR VIEW, LOWER LEFT ARM)
Deep layer of extensor muscle group of lower arm



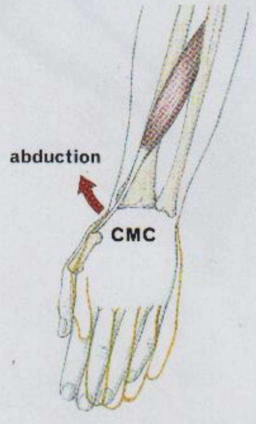
Extensor pollicis longus—extension of thumb at CMC, MCP, and IP joints



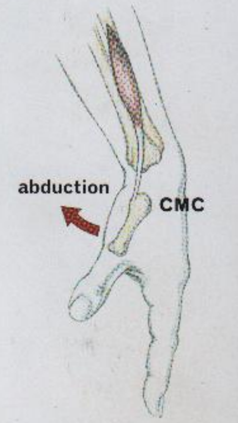
Extensor pollicis brevis—extension of thumb at CMC and MCP joints



Abductor pollicis longus—extension of thumb at CMC joint



Abductor pollicis longus—radial abduction of wrist



Abductor pollicis longus—abduction of thumb at CMC joint

THUMB MUSCLE GROUP—ACTION OF MUSCLES

swelling near the wrist area. It is their tendons, however, that are more readily seen—in the anatomical snuffbox.

ACTION OF THE MUSCLES

The main action of the abductor pollicis longus is to abduct the thumb at the CMC (carpo-metacarpal) joint, which is the movement of pulling the thumb forward and away from the palm of the hand. It also assists in the extension of the thumb at the CMC joint and in the abduction of the hand from the wrist (radial abduction), which is the movement of leaning the hand sideways from the wrist toward the radial side of the arm.

The extensor pollicis brevis, along with the extensor pollicis longus, extends the thumb at the CMC and MCP (metacarpo-phalangeal) joints.

The extensor pollicis longus extends all the joints of the thumb at the CMC, MCP, and IP (inter-phalangeal) joints, producing the thumbs-up gesture.

Thumb Muscle Group

ABDUCTOR POLLICIS LONGUS

PRONOUNCIATION ab-DUCK-tor PAWL-lih-kiss LON-gus *or* ab-DUCK-tor poe-LEE-siss LON-gus

ORIGIN OF TERM Latin *abducere* = to take away + *pollicis* = of the thumb + *longus* = long

SYNONYMS musculus abductor pollicis longus (TA), extensor ossis metacarpi pollicis, APL

EXTENSOR POLLICIS BREVIS

PRONOUNCIATION ek-STEN-sor PAWL-lih-kiss BREV-iss *or* ek-STEN-sor poe-LEE-siss BREH-viss

ORIGIN OF TERM Latin *extendere* = to stretch out + *pollicis* = of the thumb + *brevis* = short

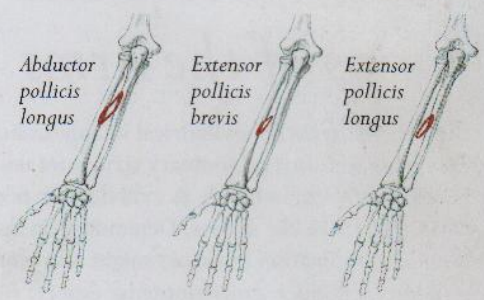
SYNONYMS musculus extensor pollicis brevis (TA), extensor brevis pollicis, EPB

EXTENSOR POLLICIS LONGUS

PRONOUNCIATION ek-STEN-sor PAWL-lih-kiss LON-gus *or* ek-STEN-sor poe-LEE-siss LON-gus

ORIGIN OF TERM Latin *extendere* = to stretch out + *pollicis* = of the thumb + *longus* = long

SYNONYMS musculus extensor pollicis longus (TA), extensor longus pollicis, EPL



THUMB MUSCLE GROUP—MUSCLE ATTACHMENTS

ORIGIN: ABDUCTOR POLLICIS LONGUS
- posterior surface of ulna
- posterior surface of radius
- interosseous membrane

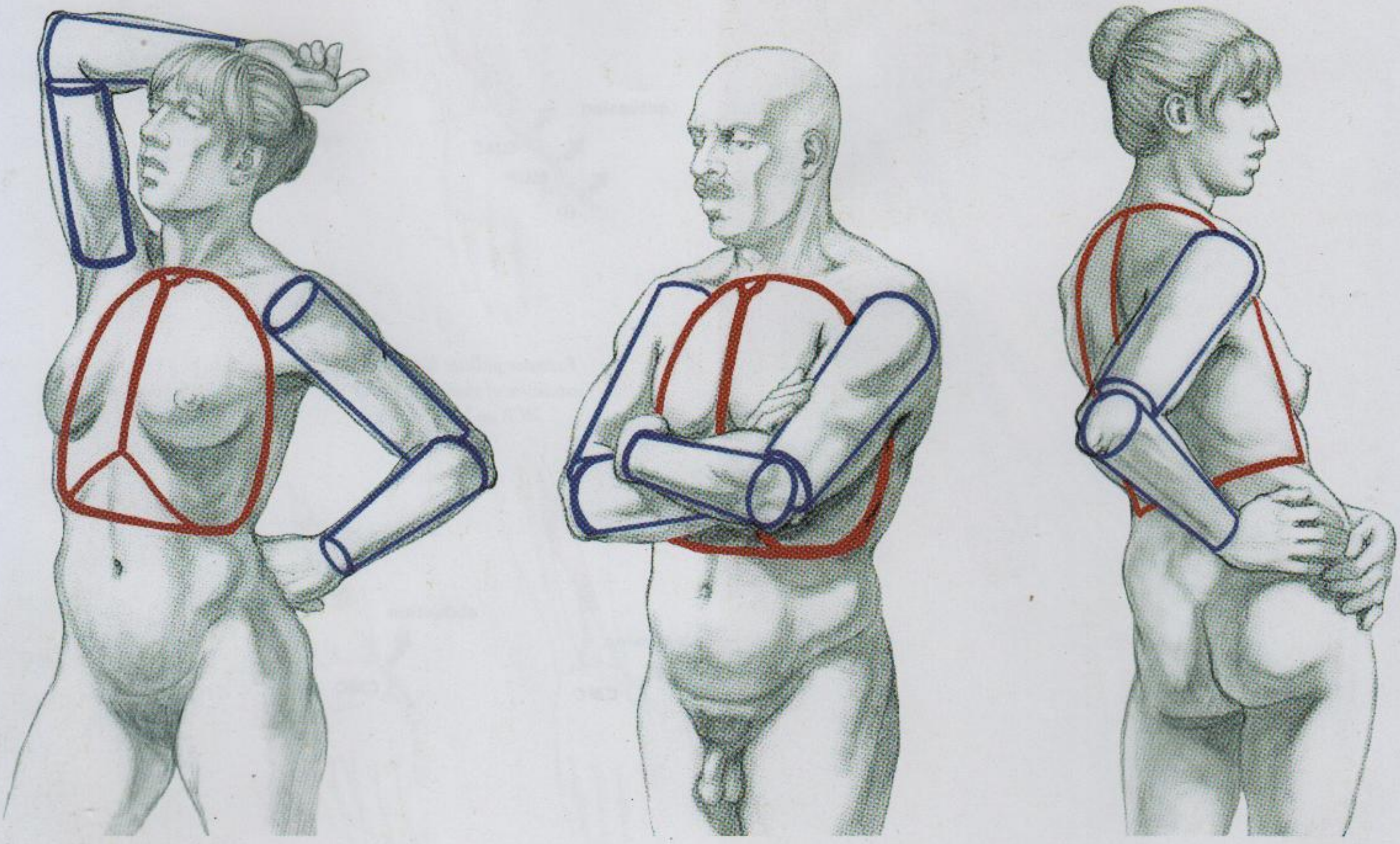
INSERTION: ABDUCTOR POLLICIS LONGUS
- base of first metacarpal (lateral side)

ORIGIN: EXTENSOR POLLICIS BREVIS
- posterior surface of radius
- interosseous membrane

INSERTION: EXTENSOR POLLICIS BREVIS
- base of proximal phalanx of thumb

ORIGIN: EXTENSOR POLLICIS LONGUS
- posterior surface of ulna
- interosseous membrane

INSERTION: EXTENSOR POLLICIS LONGUS
- base of distal phalanx of thumb



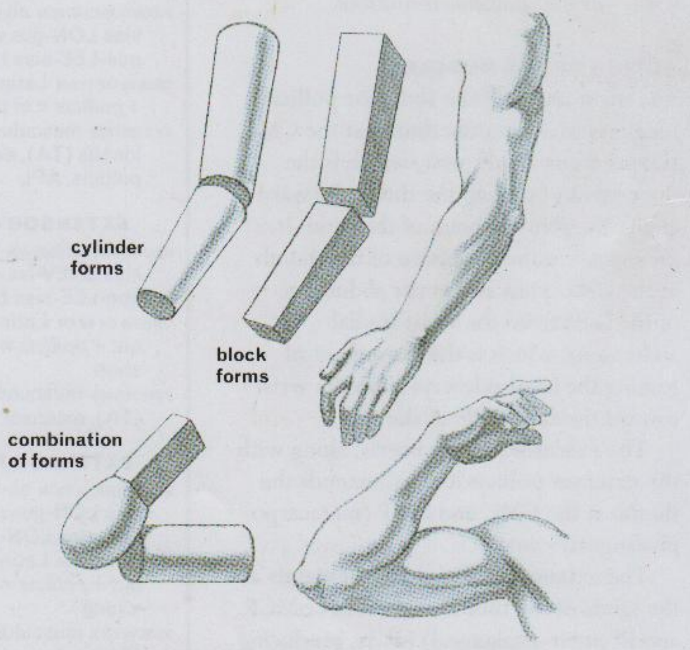
STRUCTURE OF ARMS WITH TORSO

The Structure and Surface Forms of the Arms

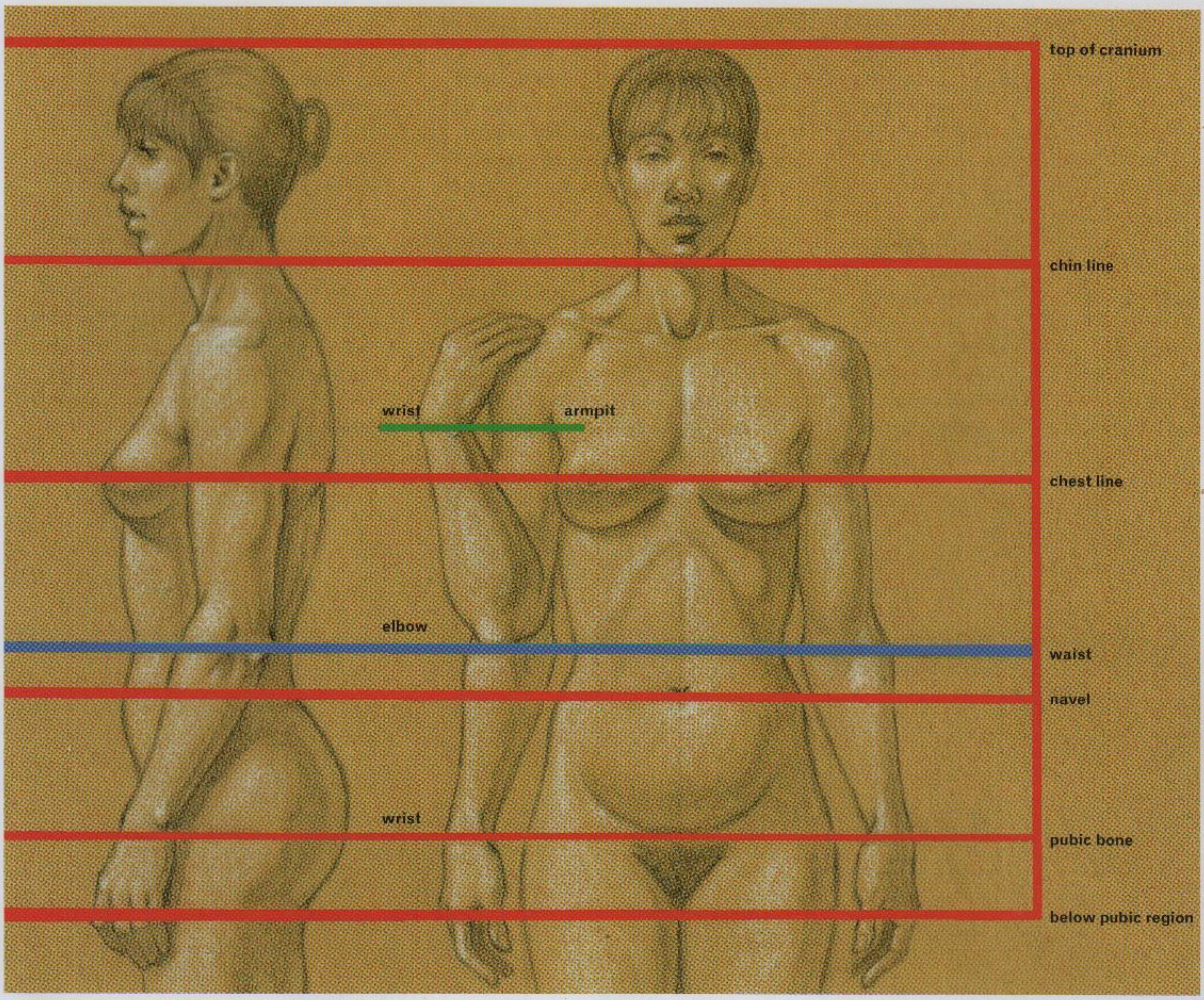
Because the arms are cylindrical in appearance, they are relatively easy to depict. In a preliminary structural underdrawing, you may sketch them in lightly as cylinders or as elongated, rectangular, boxlike shapes. Depending on the position of the arms, a combination of shapes might also work. To give the structure a fleshier, more muscular aspect, you might also sketch in organic shapes (ovals, egg shapes) indicating the major muscles' basic positions.

How the arms attach to the torso depends on their position in relation to the torso. You can think of the structure of the torso as being similar to a dress mannequin with cutout holes for the cylindrical forms of the upper arms. This might work well when the arms are positioned close to the torso. When the arms are lifted overhead or pulled out away from the torso, watch how the shapes of the deltoid and pectoralis major anchor on the cylinder of the upper arm.

Keep in mind that whatever structural devices you use, they should be lightly drawn. Quickly capture the general shapes of the arms, their basic length and width, and their alignment(s) in relation to the torso. Then you can begin fleshing out the anatomical forms.



DEPICTING THE ARM—THREE METHODS



PROPORTIONS OF ARM IN RELATION TO TORSO
Left: Lateral view. Right: Anterior view.

Proportions of the Arm

The upper arm, which extends from the top of the shoulder to the elbow joint, is longer than the lower arm, which begins at the elbow joint and continues to the wrist. The lower arm can, however, appear longer because the brachioradialis and extensor carpi radialis longus muscles (the radial group) actually begin in the upper arm on the lateral side and spiral downward toward the thumb, creating the illusion of a little extra length to the lower arm. To avoid misinterpreting the proportions of the arms, keep an eye on the location of the elbow (olecranon) or of the skin crease at the anterior portion of the arm on the elbow joint, as these help indicate the approximate place of transition between the upper and lower arm.

When the arm is in a natural position, the elbow more or less aligns with the waist. The wrist approximately aligns with the anatomical center of the standing figure, which is the position of the pubic bone and the greater trochanter of the femur (upper leg bone), though the wrist is slightly lower on some individuals. When the lower arm is flexed, or bent, so that the hand is positioned near the shoulder, the wrist tends to align approximately with the armpit. (This occurs only when the elbow remains near the waist.)

The width of the arm varies along its length because of the richness of the various muscles, but a good strategy for avoiding wrists that are too fat or elbow joints that are too skinny is to remember that the width of the arm gently decreases at each joint region. The shoulder joint (where the arm attaches into the torso) is the widest, usually accentuated by the deltoid muscle; the width of the elbow joint is slightly narrower, and the wrist joint narrower still.

The lower arm can be mentally divided in half midway between the elbow joint and wrist. Above this halfway division, the muscles are generally thicker and the form more rounded; below the halfway division, the arm tapers and becomes more angular and rectangular because of the elongated tendons in this region.

When the arms hang down naturally at the sides of the torso, the upper arm is usually positioned in a vertical alignment. The lower arm, however, does not hang vertically but slopes at a gentle angle because of the shape and configuration of the bones of the elbow joint. The lower arm can be positioned in an absolutely vertical alignment only by a forced extension of the bones and muscles. This is sometimes referred to as the military position of "attention" (with the shoulders thrown back). It is not a natural position of the arms.

In a natural arm position, the palm of the hand tends to face toward the torso. When the arm takes the anatomical position, the palm faces toward the front. As was discussed earlier in the book, the anatomical position of the arms is not a natural position but a reference pose devised by anatomists to make sure the radius and ulna bones are not crossed over each other, thereby allowing easy viewing of the anterior and posterior groups of arm muscles.

When the arm in the anatomical position is observed from either the front or back view, the upper arm is vertical (as in the natural arm position) but the lower arm angles slightly outward from the elbow joint. The angle is called the *carrying angle,* and it results partly from the shape of the bones in the elbow joint. Some anatomists have noted that the angle is the same as the angle that occurs when a person is carrying an awkward object (such as a bucket full of water), causing the object to swing farther out and preventing it from colliding with the body.

The arm region has a number of interesting surface landmarks, including the bony landmark of the elbow and the fleshy horseshoe shape of the triceps (in muscular individuals) discussed earlier. A few other examples follow. Do note that while these landmarks are sometimes evident on the surface, their prominence varies from person to person and they cannot be seen on some people's arms.

Cubital Fossa

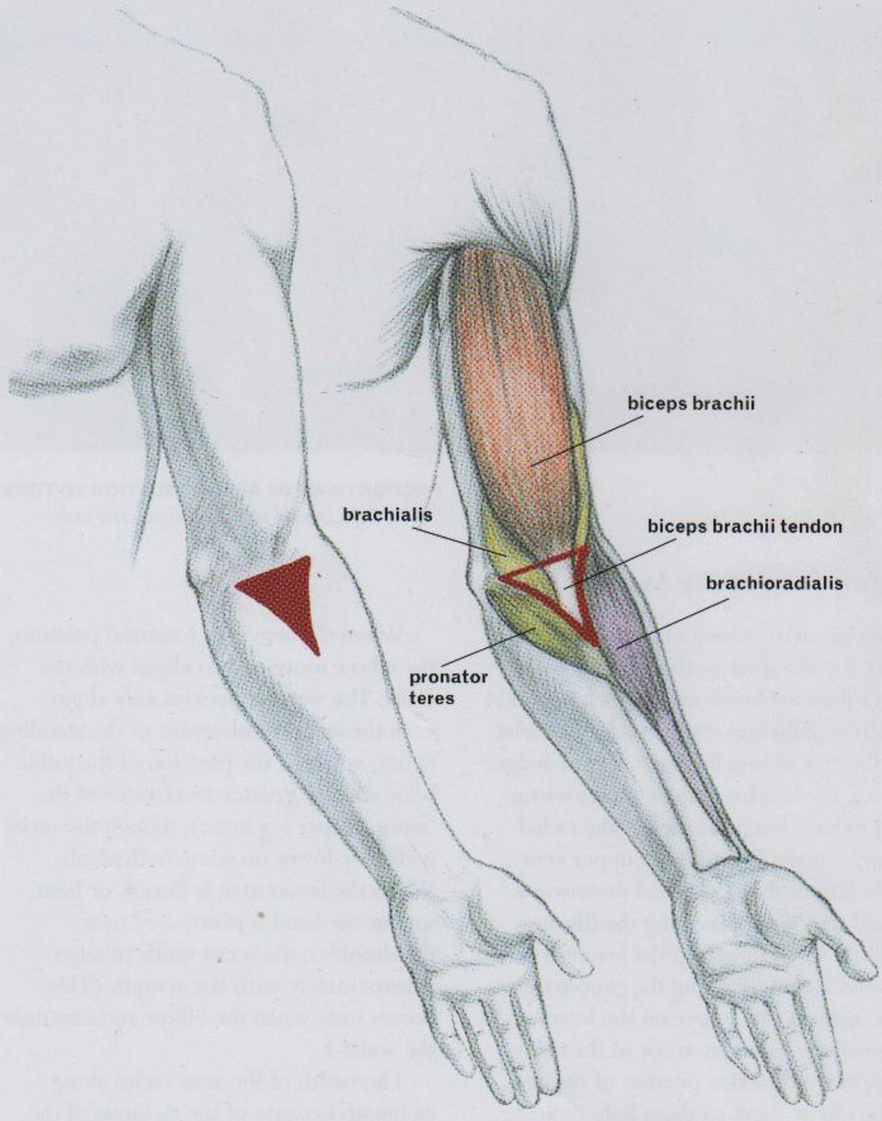
PRONOUNCIATION
KYOO-bih-tul FOSS-ah

ORIGIN OF THE TERM
Latin *cubitus* = elbow + *fossa* = trench, ditch

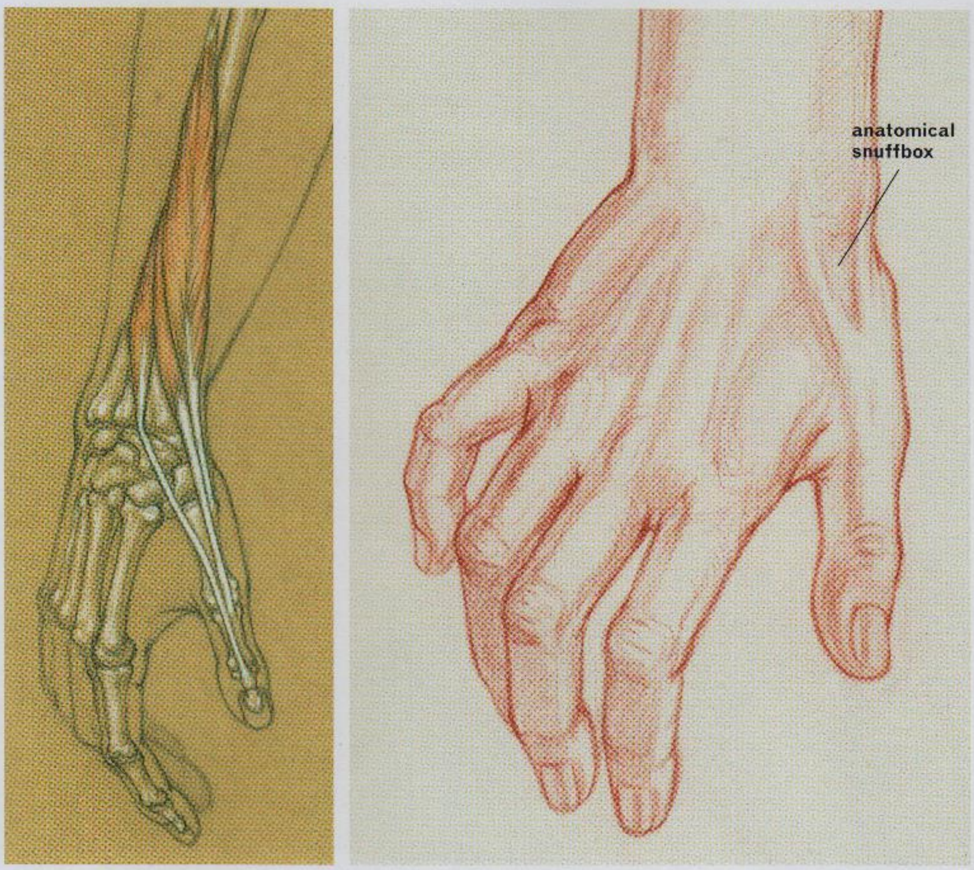
SYNONYMS
fossa cubitalis (TA), antecubital fossa, hollow of the elbow, pit of the elbow

Cubital Fossa

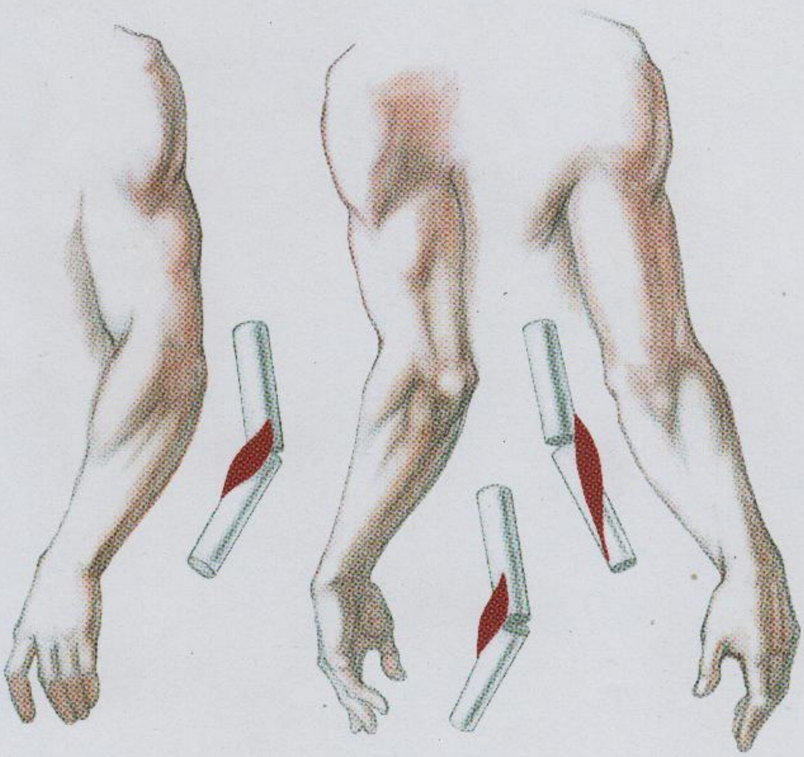
The cubital fossa is a shallow, triangular depression that occurs on the anterior aspect of the arm just below the elbow crease. Its lateral border is the inside edge of the brachioradialis muscle; its medial border is the inside edge of the pronator teres muscle; and its top border lies very near the crease of the elbow, between the medial and lateral epicondyles. The floor of the cubital fossa is formed by the brachialis. The tendon of the biceps brachii submerges in the center of the cubital fossa. The skin that pulls over the muscles of this region dips slightly in the center, emphasizing the triangular depression. This depression is usually most visible when the arm is in middle position of the pronation movement (with the hand rotated backward) or when the arm is encountering strong resistance, as when the arm or hand is pressing against something.



CUBITAL FOSSA (ANTERIOR VIEW, LOWER LEFT ARM)
The cubital fossa is a triangular depression in the skin on the anterior side of the arm



ANATOMICAL SNUFFBOX
Tendons of the deep-layer thumb muscle group create a triangular depression near the wrist.



RADIAL MUSCLE GROUP
Spiral action of brachioradialis and extensor carpi radialis longus

Anatomical Snuffbox

SYNONYMS
tabatière anatomique,
anatomic snuffbox,
radial fossa, foveola radialis

Anatomical Snuffbox

The elongated triangular depression seen near the wrist on the dorsal side of the hand when the thumb is extended is known as the anatomical snuffbox. The reason for the unusual name is that this depression was used as a natural vessel, or "spoon," for snuff (ground tobacco). In the period when using snuff was fashionable, the snuff was placed in this depression, and then the hand was lifted to the nose so that the snuff could be sniffed up into the nostrils.

The tendons of the abductor pollicis longus and the extensor pollicis brevis muscles form the lateral border of the anatomical snuffbox; the tendon of the extensor pollicis longus forms its medial border; and the scaphoid and trapezium carpal bones form the triangular depression's floor. The apex of the triangle points toward the thumb.

Artistically, this landmark is a good indicator of the dynamic tension that occurs in hand gestures in which the thumb is extended, as in the thumbs-up gesture.

Radial Muscle Group of the Upper Limb

Let's close our discussion of the anatomical forms of the arm by returning to a topic that has already been briefly alluded to. Some anatomical experts group the brachioradialis muscle of the upper arm and the extensor carpi radialis longus muscle of the lower arm into a separate, special group, which they call the radial muscle group. Together, these two muscles create the rich muscular form that appears on lateral side of the humerus near the elbow joint. As both muscles spiral downward toward the thumb region, they create a dynamic shape that is an important landmark for artists to observe. It is most noticeable in the movement of pronation, when the hand turns toward the back, twisting the lower arm.

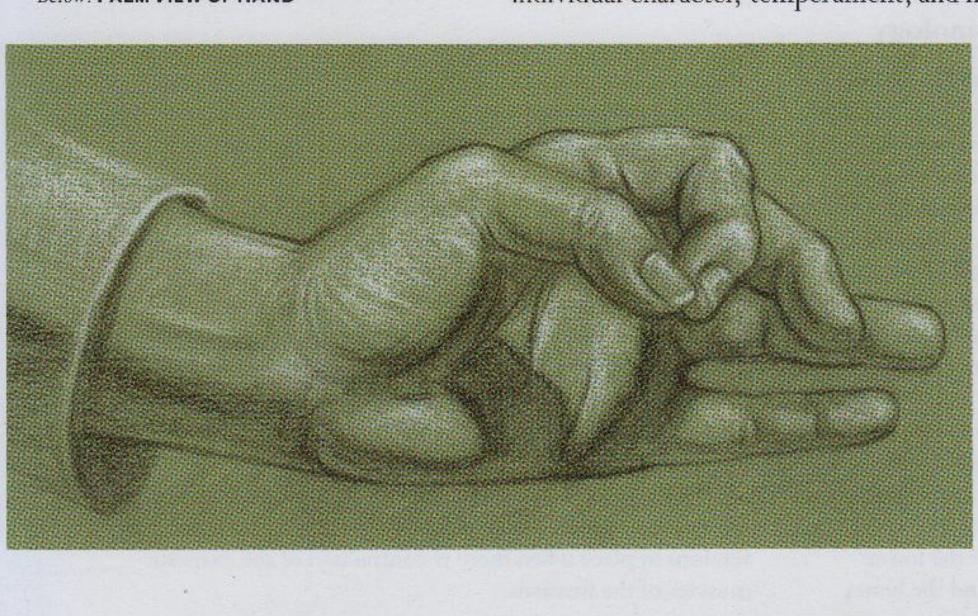
Chapter 5 The Hand

The hand is one of the most difficult components of the human figure to depict; many artists find it even more complicated to analyze than the head. The basic mass of the hand is a block-like shape, but the digits and their ability to bend and extend in a variety of positions make the hand challenging to draw, paint, and sculpt. (Sculptors have the additional challenge of having to depict the hand in three dimensions and to make sure that the forms of the hand are structurally sound in all views.)

Being able to depict hands with confidence is very important. Your knowledge of the hand's anatomical structure and your ability to depict hands for compositional or expressive purposes will be great assets to your figurative work. If your work uses human figures in motion or in narrative compositions, hands and their gestures will be key elements in communicating moods, feelings, and emotions in nonverbal ways. If you are a portrait artist, your ability to incorporate interesting hand positions into your portraits will help convey the character of the people you depict.

Human beings have long thought the forms of the hand significant for determining people's character, destiny, and health. Greek physicians Hippocrates and Galen studied the hand as a reference for medical diagnoses. And the ancient art of hand reading (also known as chirology, chiromancy, palm reading, and palmistry) was developed to interpret the markings of the palm and the characteristics of the fingers and thumb as a means of accessing individual character, temperament, and health, as well as to foretell a person's future. The Vedic scriptures of India contain texts on hand-reading practices, and this knowledge later spread to China, the Middle East, Egypt, and Greece. From the Middle Ages on, the hand-reading arts were preserved by the Roma nomads who moved across Europe from the East. The observations of the hand that have filtered down to us from various cultures over thousands of years remain useful to present-day visual artists.

Opposite: **TWO HANDS POSED**
Below: **PALM VIEW OF HAND**



HAND AND APPLE

The Bones of the Hand

The bones of the hand are as follows:

- The eight *carpal bones* of the wrist
- The five *metacarpal bones,* which are the bones that construct the hand block
- The three *phalanges* (finger bones) of each finger
- The two phalanges (thumb bones) of the thumb

The Hand—Basic Forms and Terminology

The hand has two surfaces: an anterior surface, called the *palmar side,* and a posterior surface, called the *dorsal side, dorsum of the hand,* or *back of the hand.* The two sides have different qualities: On the palmar side, the muscle forms are more evident near the surface, and the palm and fingers have fibrous padding as well as obvious creases. The dorsal side is more streamlined, with no fibrous padding; the skin of the dorsal side pulls relatively tightly across the tendons and bones.

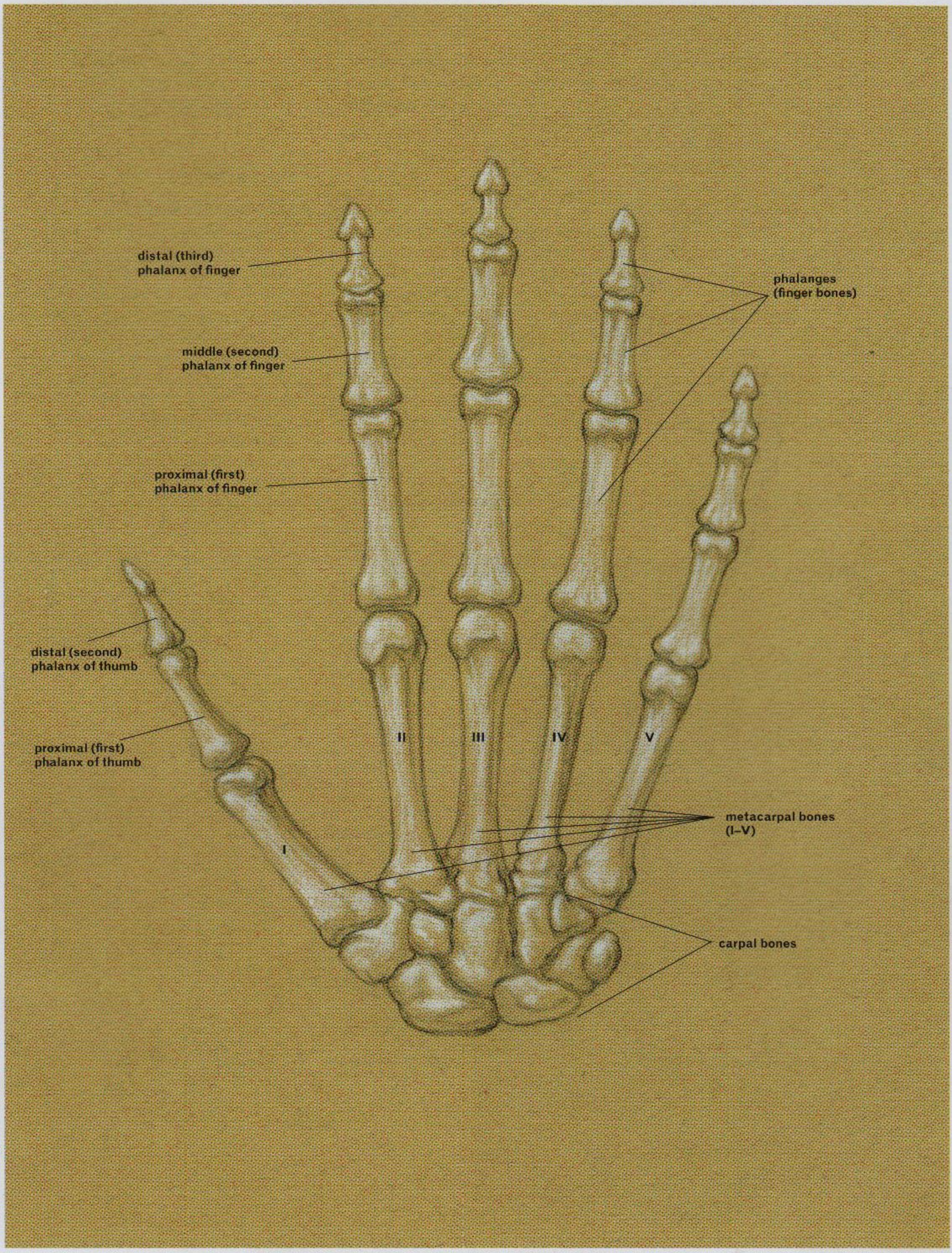
Two types of muscles—the *intrinsic muscles of the hand* and the *extrinsic muscles of the hand*—contribute to the movement of the fingers, thumb, and wrist.

The intrinsic muscles, small muscles that mostly originate on the bones of the hand, are responsible for the precise movements of the thumb and fingers that occur in actions requiring extreme control and dexterity.

The extrinsic muscles mostly originate at the lower portion of the upper arm bone (humerus) and the bones of the lower arm (radius and ulna). These muscles attach into the hand and wrist by long tendons. The extrinsic muscles mainly perform "power grip" movements requiring more strength.

On the palmar side, a wide, tendinous ligament called the *flexor retinaculum* (or *transverse carpal ligament*) is attached to four of the carpal bones: the pisaform, the hook of the hamate (a hooklike projection on the hamate), the trapezium, and the scaphoid. It forms a tunnel on the carpal arch (the *carpal tunnel*) through which the long tendons of the flexor muscles pass to attach into the fingers. Some of the hand muscles of the thenar and hypothenar groups attach directly into the flexor retinaculum.

The dorsal side of the hand has an equivalent structure: the *extensor retinaculum.* This ligament helps to hold the extensor tendons in place when there is contraction of the extensor muscles of the forearm.



BONES OF THE HAND (ANTERIOR VIEW/PALMAR SIDE, LEFT HAND)

The Carpal Bones

The carpal bones (Latin *carpus* from Greek *karpos* = wrist) are small, irregularly shaped bones joined together by various interosseous ligaments. These bones are arranged in two rows, called the *proximal row* (nearer the forearm) and the *distal row* (farther from the forearm).

The proximal row contains the *scaphoid, lunate, triquetral,* and *pisaform* bones. These bones (with perhaps the exception of the pisaform) tend to move independently of each other, in gliding movements. The distal row contains the *trapezium, trapezoid, capitate,* and *hamate* bones, which tend to function as a single unit.

The multiple bones of the wrist act as little shock absorbers whenever there is a strong impact to the hand. The carpal bones are not really individually evident on the surface form, except at the heel of the hand, where the bony bump beneath the padding indicates the location of the pisaform bone. Also, a slight bump near the wrist below the thumb eminence is formed by the scaphoid bone protruding close to the skin.

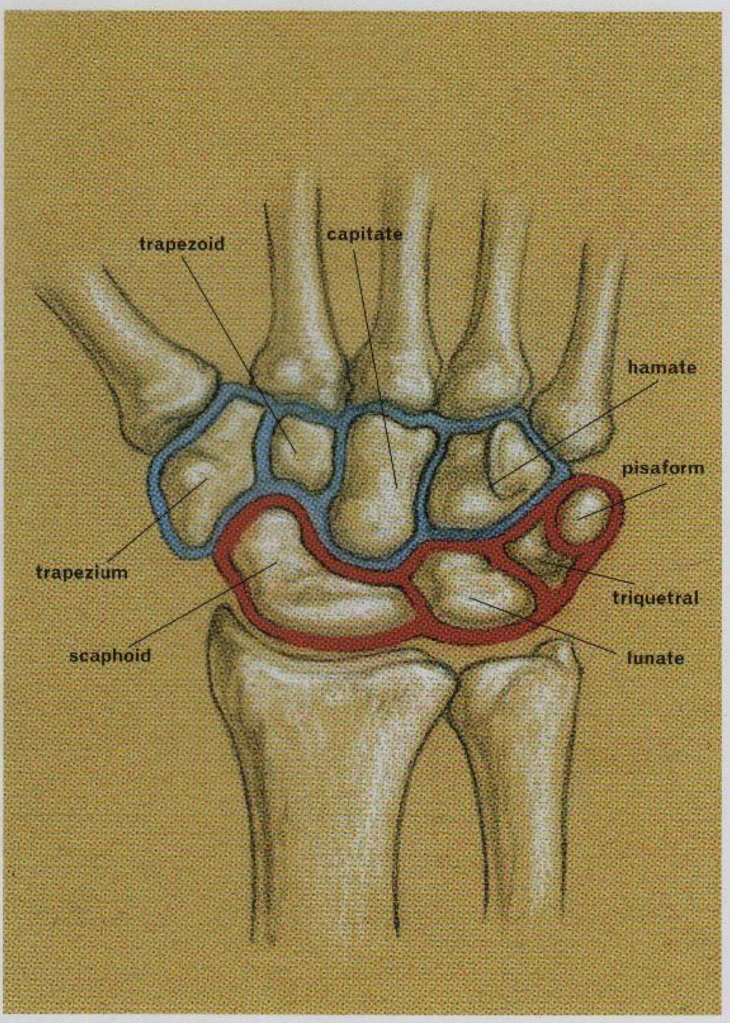
The Metacarpals

The metacarpal bones (Greek *meta* = after + Latin *carpus* from Greek *karpos* = wrist) are the elongated bones positioned beyond or after the carpal bones and forming the general structure of the hand block. The metacarpal bones are usually designated as numbers I through V (or 1 through 5): The first metacarpal is the thumb metacarpal, the second is the index finger metacarpal, and so on.

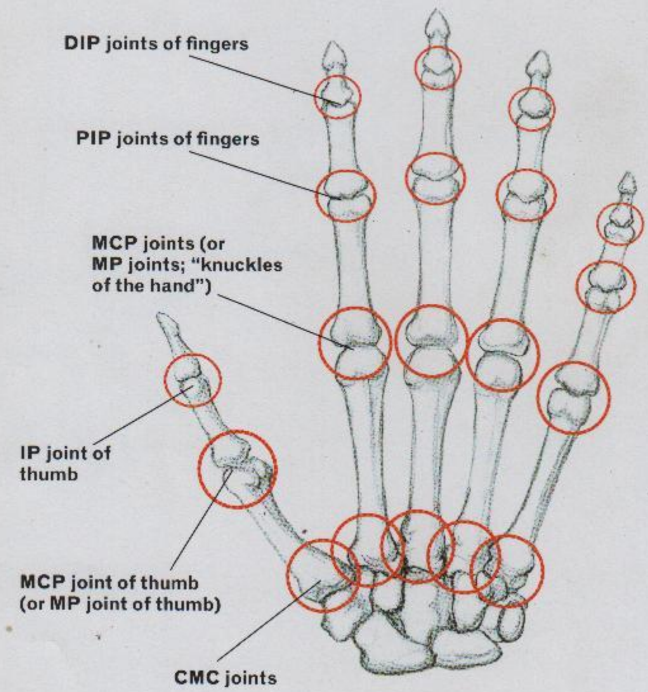
The heads of the metacarpals—commonly called the knuckles—show most clearly when the fingers are bent dramatically, as in a fist. The thumb metacarpal is shorter and thicker than the other metacarpals and is positioned more or less sideways on the hand.

The Phalanges

The bones of the thumb and fingers are called phalanges (sing., *phalanx,* from the Greek term for a line, or flank, of soldiers, because it was thought that these bones looked like soldiers lined up in battle formation). Each finger has three phalanges: The largest, called the *proximal phalanx* (or *first phalanx*), is nearest the metacarpal. The next is called the *middle phalanx* (or *second phalanx* or *intermediate phalanx*). The final phalanx, called the *distal phalanx* (or *third phalanx*) is the smallest and farthest from the metacarpal. The thumb contains only two phalanges, the proximal (first) and distal (second).



CARPAL BONES OF THE HAND (ANTERIOR VIEW/PALMAR SIDE, LEFT HAND)
Blue lines indicate the distal row; red lines indicate the proximal row.



JOINTS OF THE HAND (ANTERIOR VIEW/PALMAR SIDE, LEFT HAND)

The Joints of the Hand

Because the hand is such an important structure for artists to understand, it is essential to know something about the joints of the hand. This information will help you to see how the muscles attach into the bones of the hand and to comprehend the basic mechanisms of hand movement.

If you break down the names of the hand joints into their component parts, their meanings and positions become apparent. For instance, if you break the term *carpo-metacarpal* [joint] apart, you see that it consists of the elements *carpo* and *metacarpal,* indicating that it refers to a joint between a carpal bone and a metacarpal bone.

The abbreviations of the joints' names appearing in the following list are standard medical terms and provide a useful shortcut in learning these joints.

- IP joint (inter-phalangeal joint). A joint between two phalanges. In each finger, the three phalanges are joined by two joints generally referred as the inter-phalangeal joints (IP joints). To distinguish between the two joints, the terms *distal* and *proximal* are added.
- DIP (distal inter-phalangeal joint). A distal joint between two phalanges. On any finger, the DIP joint is the joint between the distal phalanx (farther from wrist) and the middle (intermediate) phalanx.
- PIP (proximal inter-phalangeal joint). A proximal joint between two phalanges. On any finger, the PIP joint is the joint between the proximal phalanx (closer to wrist) and the middle (or intermediate) phalanx.
- MCP (metacarpo-phalangeal joint). A joint between a metacarpal bone and a phalanx bone. Also called the MP joint, this joint is more commonly known as the *knuckles of the hand.*
- CMC (carpo-metacarpal joint). A joint between a carpal bone and a metacarpal bone.

Note that because the thumb only has two phalanges (distal and proximal phalanges), the joint between them is usually referred to as an IP joint, not as a DIP joint. The joint at the base of the thumb—where the metacarpal bone is positioned next to the thumb's proximal phalanx—is not an IP joint but rather an MCP joint.

HAND STUDIES: THREE VIEWS

MULTI-HAND STUDIES

The Three Muscle Groups of the Hand

As mentioned earlier, there are two types of muscles of the hand: intrinsic and extrinsic. The origins of the extrinsic muscles are on the lower part of the humerus and on the ulna and radius bones of the forearm. Their long tendons insert into the various carpal bones, metacarpals, and phalanges of the hand. By contrast, the origins and insertions of the intrinsic muscles attach directly on the hand. The intrinsic muscles consist of three muscle groups:

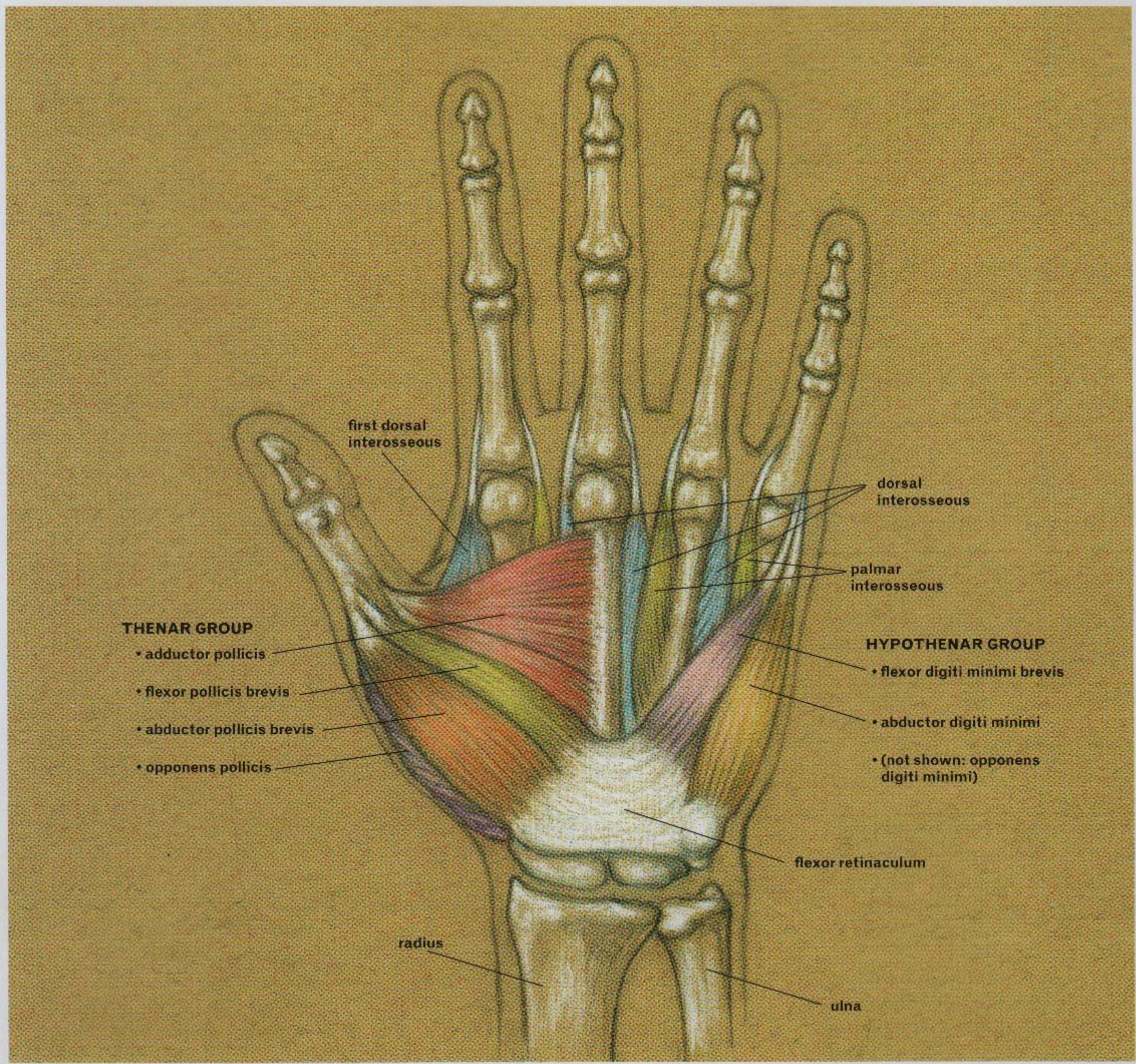
- The *thenar group,* which consists of four muscles, compose the *thumb eminence*— the thick, oval-shaped mound at the base of the thumb joints. This obvious, rich form changes shape depending on the position of the thumb.
- The *hypothenar* group, which creates the elongated, tear-shaped mound of the palm, consists of three muscles that move the little finger. This shape is usually thicker nearer the wrist and then tapers toward the little finger. The base of the shape is usually referred to as the *heel of the hand.*
- The third muscle group is the *interosseous group,* which consists of four palmar interosseous muscles and four dorsal interosseous muscles. The palmar interosseous muscles lie on the anterior portion of the metacarpals, and the dorsal interosseous muscles connect between the metacarpal bones. These muscles contribute to the actions of abduction and adduction of the fingers. The only one of these muscles that evidences itself on the surface form is the first dorsal interosseous, which connects between the thumb metacarpal and the second metacarpal of the hand.

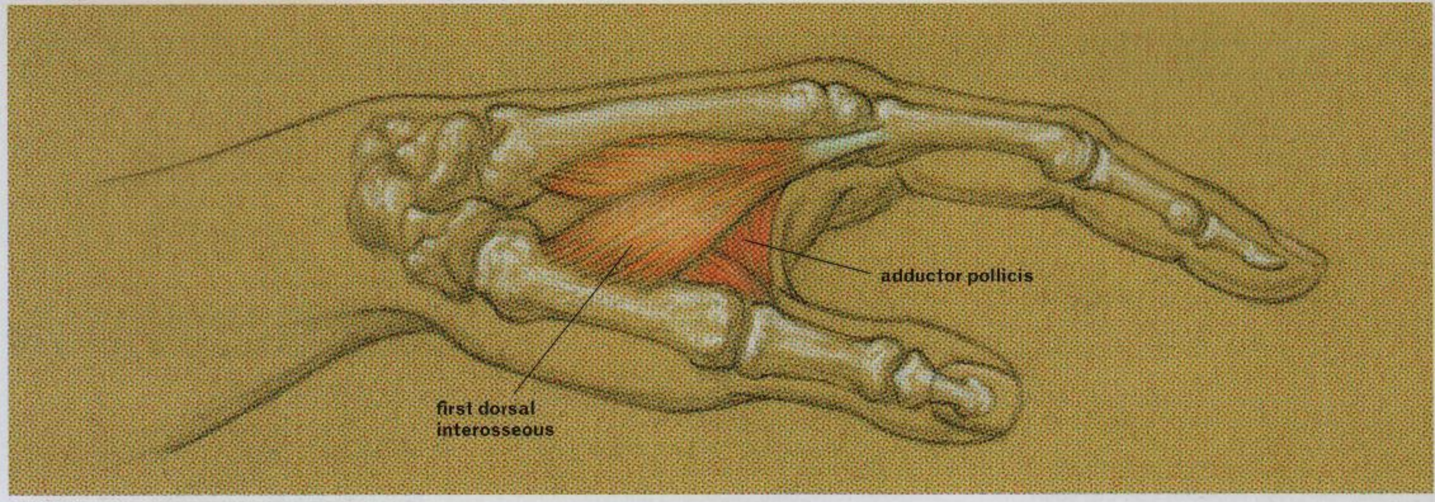
On the palmar side of the hand, the obvious surface forms are the thenar and the hypothenar muscle groups. Another surface-form characteristic of the palm is the elongated fibrous padding positioned along the base of the fingers, where they attach into the palm region. This padding breaks into separate little mounds depending on the movement of the fingers. Situated in the center of the palm, between the thenar group, hypothenar group, and the fibrous padding, is a triangular valley. As the fingers and thumbs move inward, this valley becomes a more hollow depression.

NOTE ON TERMINOLOGY

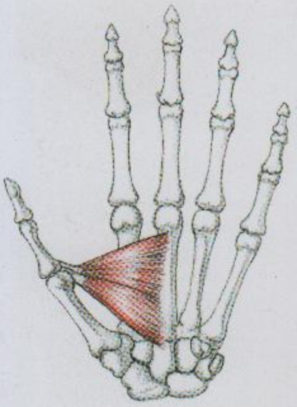
When the term *pollicis* (from Latin *pollex* = thumb) appears in a muscle's name, it indicates that the muscle attaches in the thumb region and helps move the thumb to various positions.

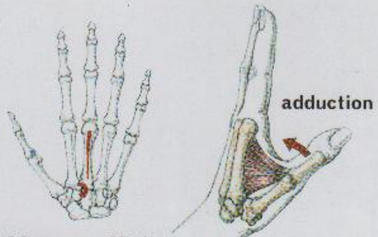
When the term *digiti minimi* (Latin: little finger) appears in a muscle's name, it indicates that the muscle attaches to the little-finger region and helps move the little finger to various positions.





MUSCLES OF THE HAND
Top: Anterior view/palmar side of left hand. Bottom: Side view of left hand.



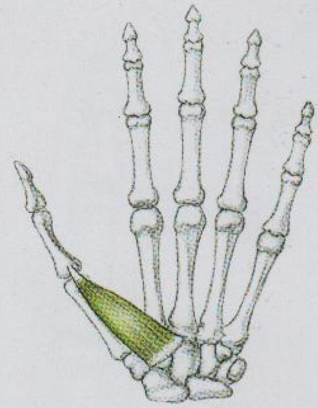


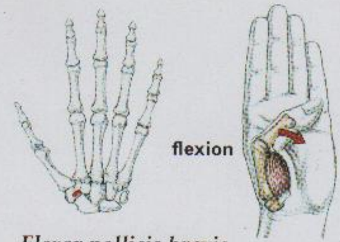
Adductor pollicis

ORIGIN (TRANSVERSE HEAD)
- front surface of third metacarpal

ORIGIN (OBLIQUE HEAD)
- capitate carpal bone
- base of third metacarpal
- base of second metacarpal

INSERTION
- base of proximal phalange of thumb (medial side)

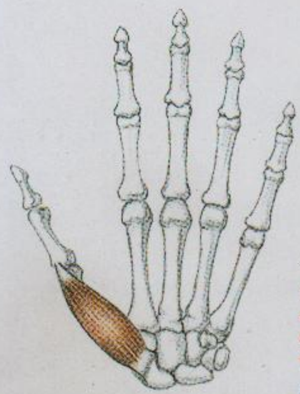


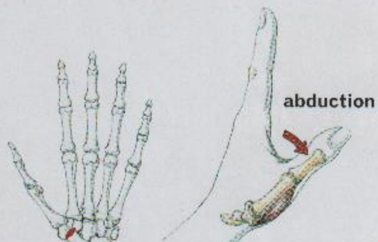


Flexor pollicis brevis

ORIGIN
- trapezium carpal bone
- flexor retinaculum

INSERTION
- base of proximal phalange of thumb (lateral side)

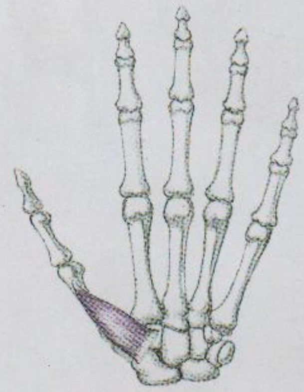


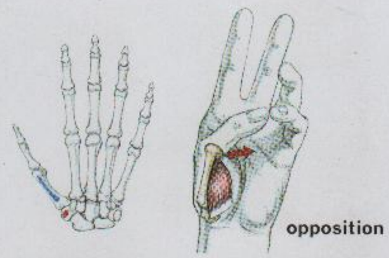


Abductor pollicis brevis

ORIGIN
- scaphoid carpal bone
- trapezium carpal bone
- flexor retinaculum

INSERTION
- base of proximal phalange of thumb (lateral side)





Opponens pollicis

ORIGIN
- trapezium carpal bone
- flexor retinaculum

INSERTION
- first metacarpal (lateral side)

THENAR GROUP

Thenar Group

The thenar group composes the rich, fleshy mound located at the base of the thumb on the lateral side of the palm. These four muscles, which contribute to the movement of the thumb, are as follows:

- The *adductor pollicis* is a fan-shaped muscle with two heads: the *oblique head* and the *transverse* head. This muscle is mainly a deep-layer muscle; just one small segment of the transverse head—located between the first interosseous muscle and the base of the thumb, and covered with loose skin—can be seen in side views of the hand.
- The *opponens pollicis* is a small, triangular muscle that lies underneath the abductor pollicis brevis and the flexor pollicis brevis. While this muscle is not evident on the surface form, its muscular shape contributes to the bulky characteristic of the thenar group.
- The *abductor pollicis brevis* (or APB) is the most superficial and largest muscle of the thenar group.
- The *flexor pollicis brevis* (or FPB), positioned next to the APB, is a narrow muscle generally hidden by palmar fatty tissue.

Thenar Group

ADDUCTOR POLLICIS

PRONOUNCIATION ah-DUCK-tor poe-LEE-siss *or* ah-DUCK-tor PAWL-lih-kiss
ORIGIN OF TERM Latin *adductus* = brought forward + *pollicis* = of the thumb
SYNONYMS musculus adductor pollicis (TA), adductor of the thumb

ABDUCTOR POLLICIS BREVIS

PRONOUNCIATION ab-DUCK-tor poe-LEE-siss BREV-iss *or* ab-DUCK-tor PAWL-lih-kiss BREH-viss
ORIGIN OF TERM Latin *abducere* = to lead or take away + *pollicis* = of the thumb + *brevis* = short
SYNONYMS musculus abductor pollicis brevis (TA), abductor pollicis, short abductor of the thumb, APB

FLEXOR POLLICIS BREVIS

PRONOUNCIATION FLEK-sor poe-LEE-siss BREV-iss *or* FLEK-sor PAWL-lih-kiss BREH-viss
ORIGIN OF TERM Latin *flectere* = to bend + *pollicis* = of the thumb + *brevis* = short
SYNONYMS musculus flexor pollicis brevis (TA), flexor brevis pollicis, short flexor of thumb, FPB

OPPONENS POLLICIS

PRONOUNCIATION oh-POE-nenz poe-LEE-siss *or* oh-POE-nenz PAWL-lih-kiss
ORIGIN OF TERM Latin *opponere* = to oppose + *pollicis* = of the thumb
SYNONYMS musculus opponens pollicis (TA), flexor ossis metacarpi pollicis

Thenar Group

PRONOUNCIATION
THEE-nar

ORIGIN OF THE TERM
Greek *thenar* = the palm

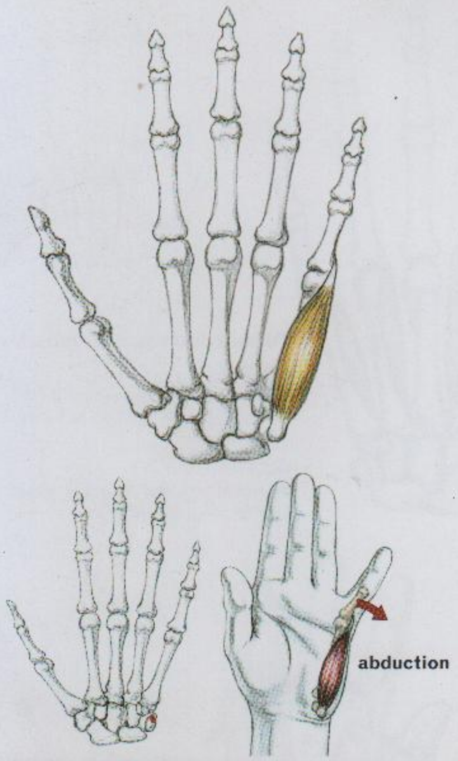
SYNONYMS
eminentia thenaris (TA), thenar eminence

Hypothenar Group

PRONOUNCIATION
hi-POTH-ih-nar

ORIGIN OF THE TERM
Greek *hypo* = under + *thenar* = the palm

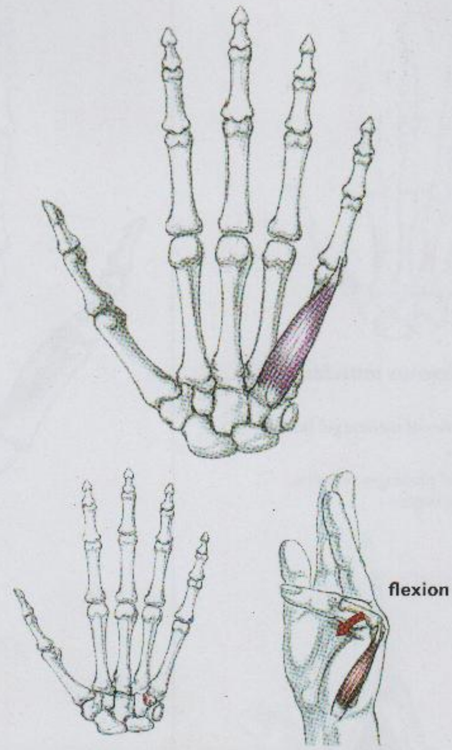
SYNONYMS
eminentia hypothenaris (TA), hypothenar eminence, antithenar eminence



Abductor digiti minimi

ORIGIN
- pisaform carpal bone

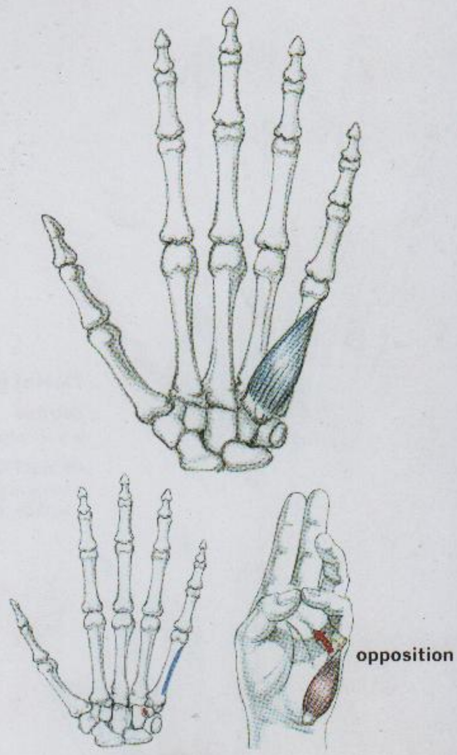
INSERTION
- base of proximal phalange of little finger (medial side)



Flexor digiti minimi brevis

ORIGIN
- hook of hamate (hooklike projection on hamate carpal bone)
- flexor retinaculum

INSERTION
- base of proximal phalange of little finger (medial side)



Opponens digiti minimi

ORIGIN
- hook of hamate (hooklike projection on hamate carpal bone)
- flexor retinaculum

INSERTION
- fifth metacarpal (medial side)

HYPOTHENAR GROUP

ACTION OF THE MUSCLES

The muscles of the thenar group perform the following actions:

- The adductor pollicis adducts the thumb, bringing it back to the palm from the position of abduction, in which the thumb is held out away from the palm.
- The abductor pollicis brevis, or APB, moves the thumb away from the palm. It helps in the performance of precise tasks requiring a pincer grip.
- The flexor pollicis brevis, or FPB, flexes the thumb, moving it back to the palm (or across the palm) from an extended position.
- The opponens pollicis moves the thumb across the palm to touch the tip of any finger. It helps in the performance of very precise, controlled actions requiring thumb and finger contact.

Hypothenar Group

The three muscles of the hypothenar group create the elongated, tear-shaped mass on the little-finger side of the palm of the hand. These muscles contribute to the movement of the little finger. The *opponens digiti minimi* lies deeper than the other two muscles of the little finger and is hard to detect on the surface form. The *abductor digiti minimi* is the largest of the hypothenar group. Its fleshy shape also occupies the side of the hand (on the ulnar side of the forearm) and can be easily seen in palm and profile views. The flexor digiti minimi brevis is positioned next to the abductor digiti minimi; its muscular shape is, however, mostly hidden by palmar fatty tissue.

ACTION OF THE MUSCLES

The muscles of the hypothenar group perform the following actions:

- The abductor digiti minimi abducts the little finger, pulling it away from the ring finger.
- The flexor digiti minimi brevis flexes the little finger, bending it toward the palm.
- The opponens digiti minimi helps in the movement of opposition, bringing the fifth metacarpal (the metacarpal of the little finger) toward the thumb.

Hypothenar Group

ABDUCTOR DIGITI MINIMI

PRONOUNCIATION ab-DUCK-tor DIH-jih-tee MIN-ih-mee *or* ab-DUCK-tor DIJ-ih-tie MIN-ih-my

ORIGIN OF THE TERM Latin *abducere* = to lead or take away + *digitus* = digit (finger) + *minimi* = smallest

SYNONYMS musculus abductor digiti minimi (TA), abductor digiti quinti, abductor of the little finger

FLEXOR DIGITI MINIMI BREVIS

PRONOUNCIATION FLEK-sir DIH-jih-tee MIN-ih-mee BREV-iss *or* FLEK-sir DIJ-ih-tie MIN-ih-my BREH-viss

ORIGIN OF THE TERM Latin *flectere* = to bend + *digitus* = digit (finger) + *minimi* = smallest + *brevis* = short

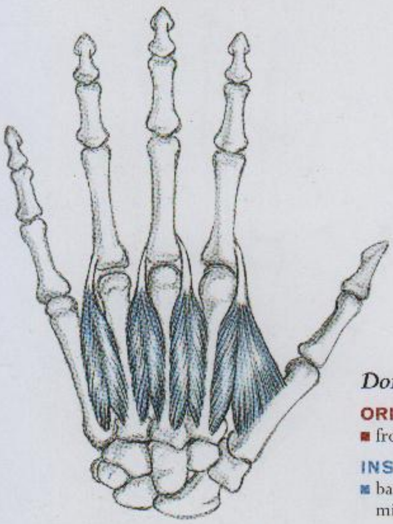
SYNONYMS musculus flexor digiti minimi brevis (TA), flexor brevis minimi digiti, flexor digiti quinti brevis, short flexor of the little finger

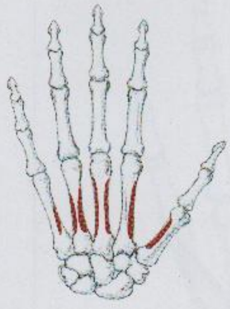
OPPONENS DIGITI MINIMI

PRONOUNCIATION oh-POE-nenz DIH-jih-tee MIN-ih-mee *or* oh-POE-nenz DIJ-ih-tie MIN-ih-my

ORIGIN OF THE TERM Latin *opponere* = to oppose + *digitus* = digit (finger) + *minimi* = smallest

SYNONYMS musculus opponens digiti minimi (TA), opponens digiti quinti





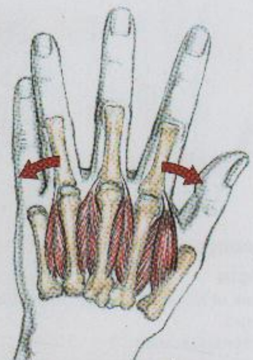
Dorsal interosseous muscles

ORIGIN

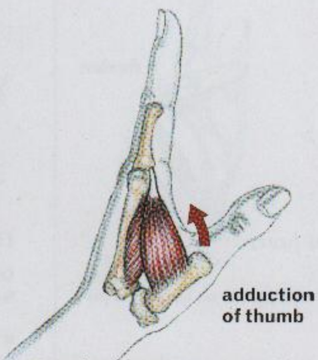
- from adjacent sides of metacarpal bones

INSERTION

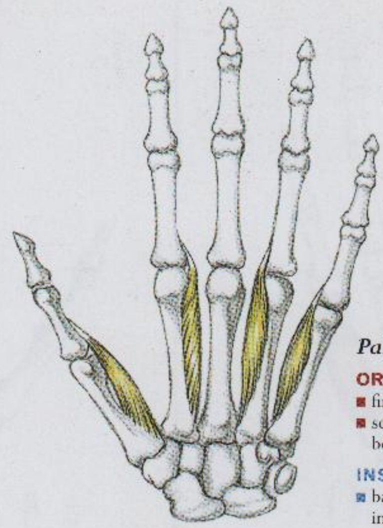
- bases of proximal phalanges of index, middle, and ring fingers

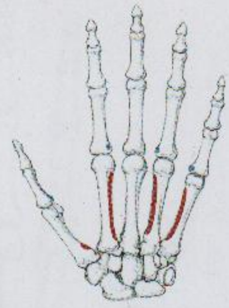


Dorsal interosseous muscles (dorsal view of left hand)



First dorsal interosseous muscle (lateral view of left hand)





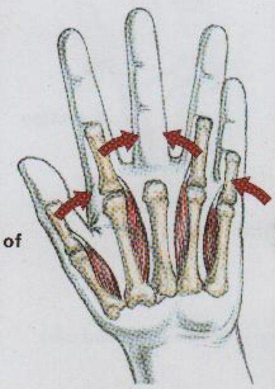
Palmar interosseous muscles

ORIGIN

- first metacarpal bone (medial side)
- second, fourth, and fifth metacarpal bones

INSERTION

- bases of proximal phalanges of thumb, index, ring, and little fingers



Palmar interosseous muscles (palmar view of left hand)

INTEROSSEOUS MUSCLES

Interosseous Muscle Group

The interosseous muscles are divided into two subgroups: the *dorsal interosseous muscles,* which are the four muscles attached to the sides of the metacarpal bones nearer the dorsal part of the hand, and the *palmar interosseous muscles,* which are the four muscles attached on the anterior aspect of the metacarpals, nearer the palm side of the hand. (Note that some experts say there are only three palmar interosseous muscles, not four. They consider the first palmar interosseous muscle [the *interosseous primus volaris*] to be a deep part of the flexor pollicis brevis muscle.)

The palmar interosseous muscles are smaller than the dorsals and are *unipennate* muscles, which means that all their muscle fibers are positioned along one side of their long tendons. The dorsal interosseous muscles, by contrast, are *bipennate.* Shaped somewhat like birds' feathers, they are attached between the metacarpal bones of the hand. The only dorsal interosseous muscle evident on the surface form is the *first dorsal interosseous,* which is attached on the thumb and the second metacarpal bone. When the hand is in a fist, with the thumb pulled tightly against the side of the hand, the rich, fleshy mound of the first dorsal interosseous appears on the back of the hand near the thumb attachment. (In the art of hand reading, this form is sometimes referred to as the *mouse.*) When the thumb is pulled away from the hand, this muscle (along with the adductor pollicis muscle) stretches out, creating a triangular form between the thumb and the block of the hand. The skin in this area is sometimes called the *thumb web.*

ACTION OF THE MUSCLES

The dorsal interosseous muscles mainly abduct the fingers, spreading the fingers apart. In abduction, the index and ring fingers move away from the middle finger, which indicates the midline (medial line, central axis) of the hand. The first dorsal interosseous muscle assists in the adduction of the thumb.

When the palmar interosseous muscles contract, they adduct the fingers, bringing the index finger, ring finger, and little finger back toward the midline of the hand from a spread-out position. These muscles also assist in the movements of flexing and extending the fingers. The first palmar interosseous muscle, acting with the flexor pollicis brevis muscle, assists in the flexion of the thumb.

Interosseous Muscle Group

DORSAL INTEROSSEOUS MUSCLES

PRONOUNCIATION DOOR-sul in-tur-OSS-see-us *or* DOOR-sul in-tur-ROSS-ee-us

ORIGIN OF THE TERM Latin *dorsum* = back + *interosseous* = between the bones

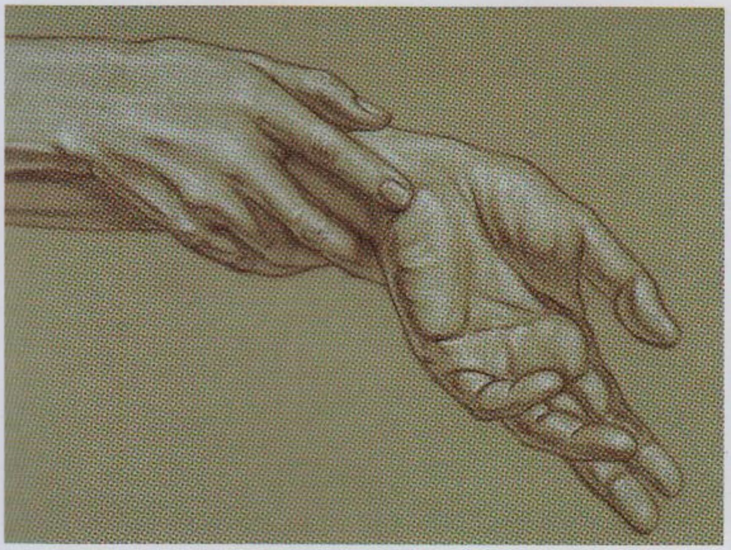
SYNONYMS musculi interossei dorsales (TA; plural form), interosseus dorsalis manus

PALMAR INTEROSSEOUS MUSCLES

PRONOUNCIATION PAHL-mar in-tur-OSS-see-us *or* PAWL-mer in-tur-ROSS-ee-us

ORIGIN OF THE TERM Latin *palma* = palm of hand + *interosseous* = between the bones

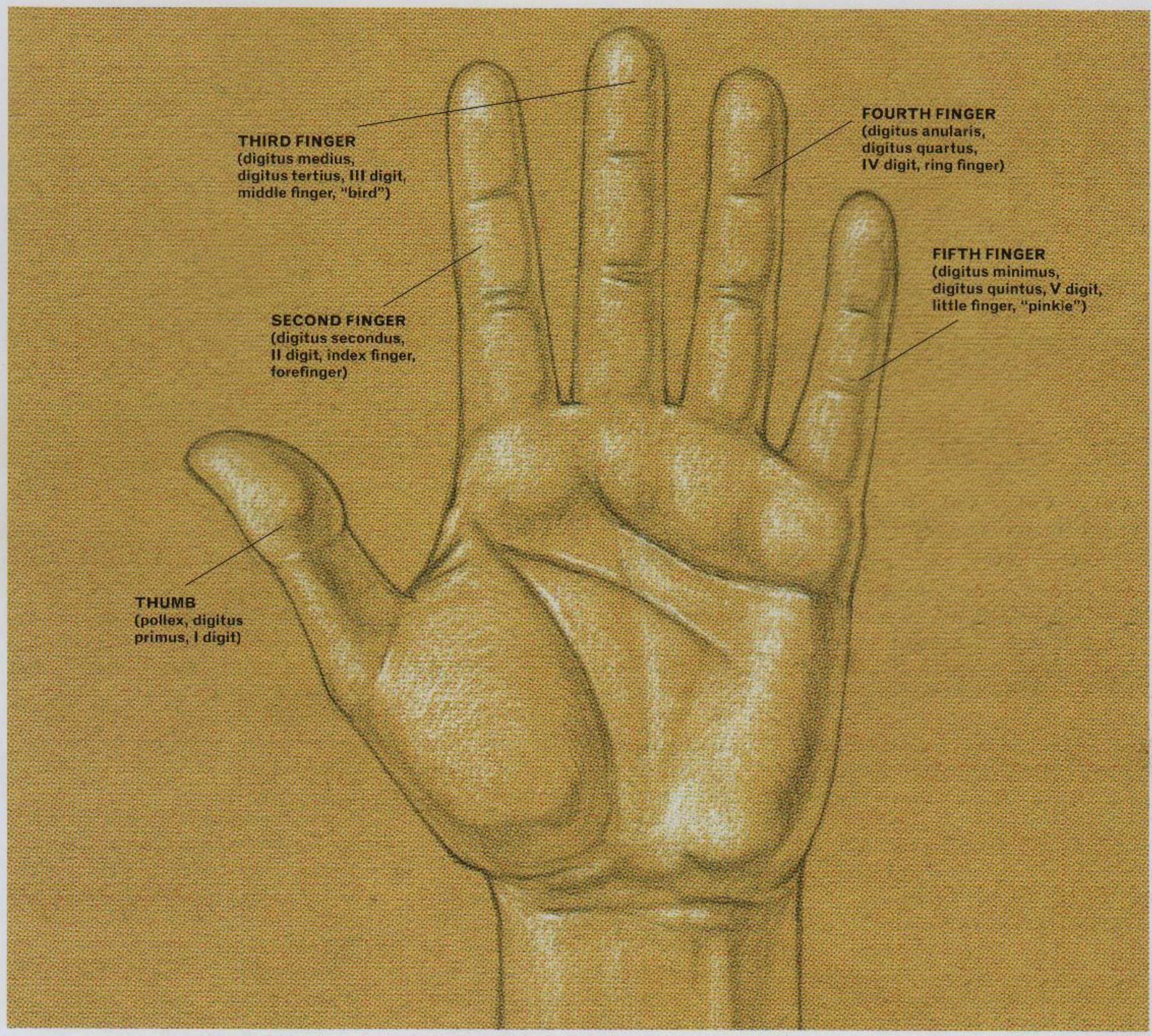
SYNONYMS musculi interossei palmares (TA; plural form), interossei volares (pl.), interosseus volaris (sing.)



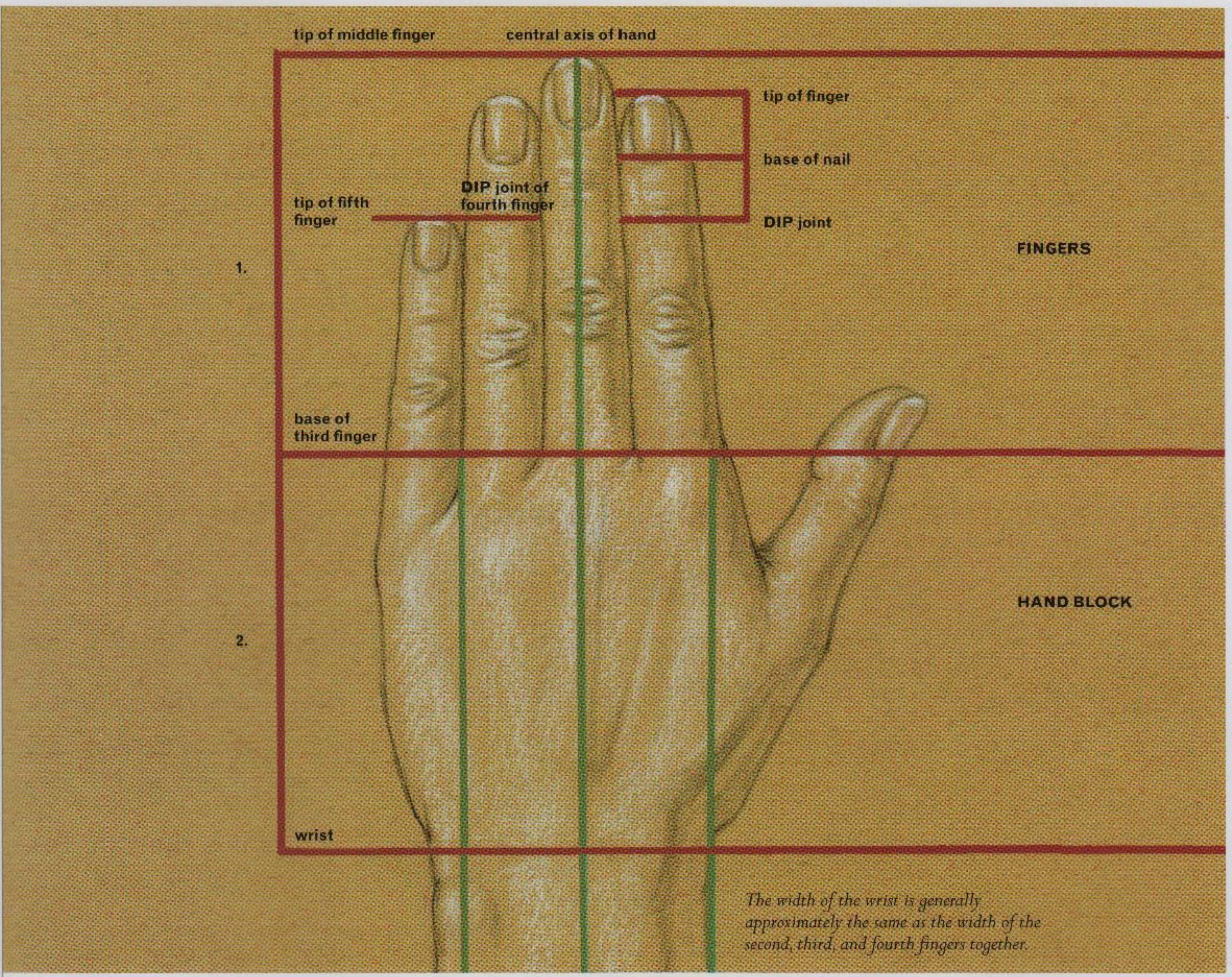
The Structure and Surface Forms of the Hand

Understanding the proportions and surface form characteristics of the hand will help clarify the hand's complex mechanics and enable you to approach the depiction of the hand with more confidence. As with any difficult subject, practice will accelerate the development of your skills. Drawing other people's hands, drawing your own (nondrawing) hand, drawing hands from photo sources or from freeze-frame video/DVD images, copying master artists' depictions of hands in sculptures, drawings, and paintings—all of these exercises will contribute to your understanding of the hand in various poses.

STUDY OF TWO HANDS



NAMES OF THE DIGITS (PALMAR SIDE, LEFT HAND)



GENERAL PROPORTIONS OF THE HAND (DORSAL VIEW, LEFT HAND)

Proportions of the Hand

Most people's hands have the same basic components—wrist, hand block, fingers, thumb—but there are tremendous differences in hand shapes and proportions. Adults' hands can be large, muscular, and robust; delicate and elongated; or very stout and compact. Finger and thumb shapes, nail shapes, skin texture and skin creases, bone quality, and palmar surface forms can also vary greatly from person to person.

Because of this tremendous variation, the proportions presented here should be considered a general guide only. Although not everyone's hand will correspond to these measurements, they can serve as a template for blocking in the overall shape. Then you must observe the unique quality of the individual's hands.

You will find the hand easier to depict if you break the shape down into three basic regions:

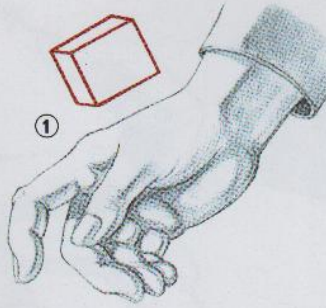
- The hand block—the main mass of the hand from the bases of the fingers and thumb to the wrist
- The fingers (seen as a unit)
- The thumb unit, which on the palmar side includes the muscles of the thenar group and on the dorsal side includes the first dorsal interosseous muscle.

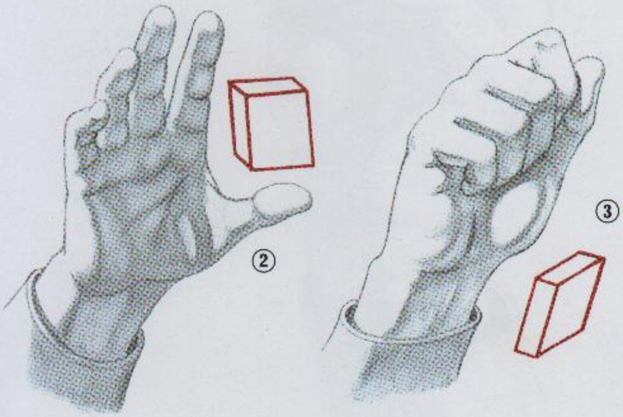
The length of the whole hand is measured from the longest finger (the third finger) to the wrist area, defined either by the bottom of the thenar group of the thumb or by the bottom heel of the hand on the little-finger side of the palm. (The heel of the hand is slightly lower than the thumb thenar group.) On most people, the length of the hand is approximately the same length as the distance from the chin to the hairline. The width of the wrist is about three fingers wide—the same as the width of the second, third, and fourth fingers when they are straight and held close together.

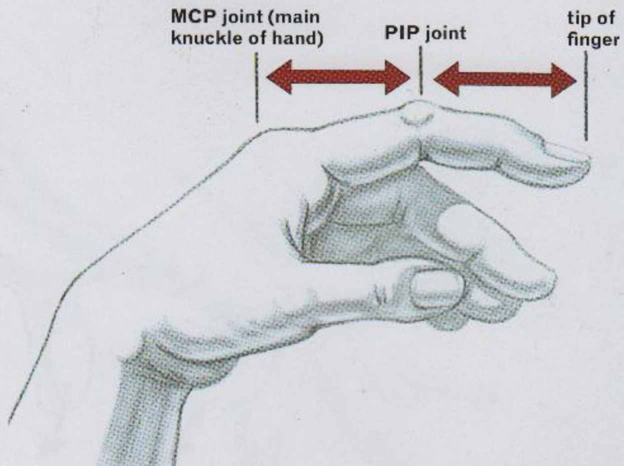
When the hand is in the anatomical position and the fingers are straight, the middle finger (third finger) is usually the longest of the four fingers. The index finger (second finger) is slightly shorter than the middle finger. The ring finger (fourth finger) is about the same length as the index finger. The tip of the little finger (fifth finger) aligns with the first joint (DIP joint) of the ring finger.

Proportionally, the fingers (considered as a unit) are about equal to the hand block, although the length of the fingers (generally measured from the base of the

Look for simplified block shapes in certain positions of the hand.

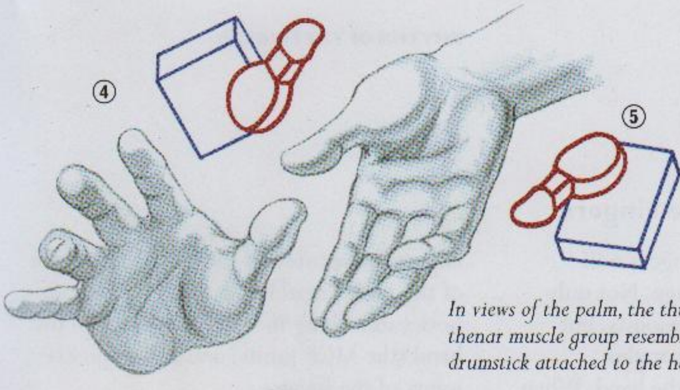






FINGER PROPORTION

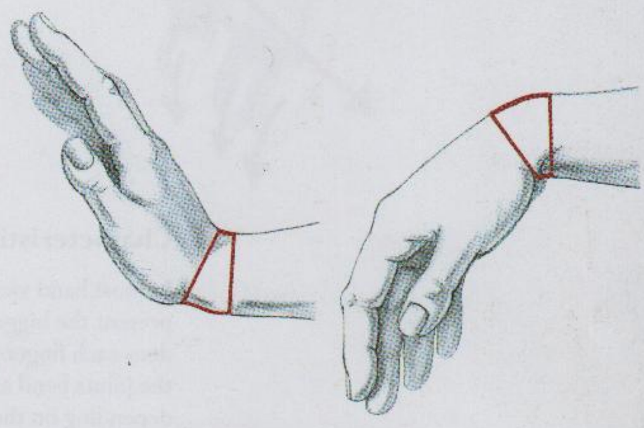
The distance from the metacarpal head (MCP joint) to the PIP joint is approximately the same length as the distance from the PIP joint to the tip of the finger.



In views of the palm, the thumb and thenar muscle group resemble a poultry drumstick attached to the hand block.

STRUCTURE OF THE HAND

1, 2, and 3: Hand block. 4 and 5: Thumb and thenar muscle group



WEDGE SHAPE OF WRIST REGION

middle finger to its tip) may be slightly shorter than the length of the hand block, measured from the base of the middle finger to the wrist.

Each finger has three joints, and on the palmar side the distances between the joints appear to be approximately the same. On the dorsal side, however, the distance from the metacarpal head (the knuckle of the hand) to the main knuckle of the finger (where the skin puckers into a wrinkled oval shape) is approximately equal to the distance from the main finger knuckle to the fingertip.

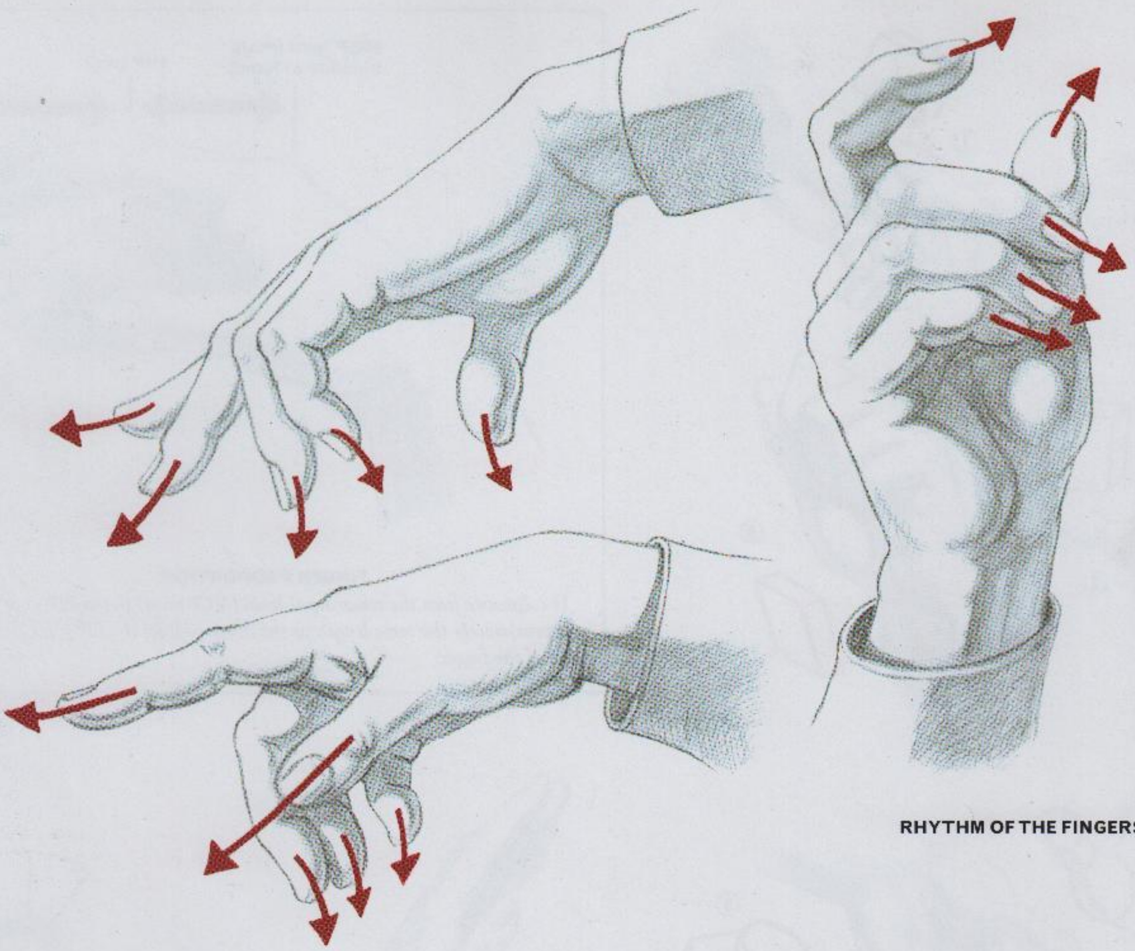
To correctly position the nail on a finger or thumb that is not foreshortened, divide the distal joint of the finger or thumb in half (from the tip of the finger to the first joint crease); this is where the nail begins.

Unlike the fingers, the thumb has only two joints. The proximal joint of the thumb (nearer the hand block) is cylindrical in character. At the next joint (the distal joint), the thumb widens before tapering toward the tip. The shape of the entire thumb is similar to that of a reptile's head. When viewed laterally, the side of the distal phalanx of the thumb (where the nail is positioned) is slightly concave, whereas the other side of the distal phalanx is slightly convex because there is more padding in this area. When the thumb is held against the hand block, with the fingers straight, the tip of the thumb is usually slightly shorter than the main knuckle (PIP joint) of the index finger.

In poses where the thumb moves away from the hand block, it should be treated as a separate form. Observe its placement in relation to the hand block in different poses. When sketching it in, think of the thumb unit's shape as similar to that of a poultry drumstick.

In views of the dorsal side of the hand, there is a triangular shape between the thumb and the hand block. This is the location of the first dorsal interosseous muscle.

The region of the wrist is very subtle on the surface form. In action poses, the lower arm generally appears to connect directly into the hand shape. But in close-up studies of hands, observe the wrist area carefully, noting how it sometimes appears as a wedge shape, marking the transition from the cylinder shape of the arm to the block shape of the hand.



RHYTHM OF THE FINGERS

Characteristics of the Fingers

In most hand views, the fingers will present the biggest challenge. Not only does each finger have three joints, but the joints bend at different angles depending on the pose of the hand. When depicting the hand gripping an object, observe how the fingers are placed in relation to the object and to each other as well as the differing angles at which the joints are bending.

When the hand is in a relaxed pose, the fingers have a natural tendency to bend slightly at the PIP joint—the area where an oval of skin folds appears on the dorsal side of the finger. The same applies to the IP joint of the thumb. By indicating this slight bend, you will give the hand a more natural look.

The finger joints do not bend naturally in a straight alignment but spiral slightly toward the central axis of the hand block. This is most noticeable when the fingers are bending gently downward toward the palm.

Keep in mind that the fingers do not attach into the hand block in a straight line but are connected in a curving alignment because of the differing lengths of the metacarpal bones. This curve is also noticeable along the main knuckles of the hand (the MCP joints) and along the PIP joints of the fingers.

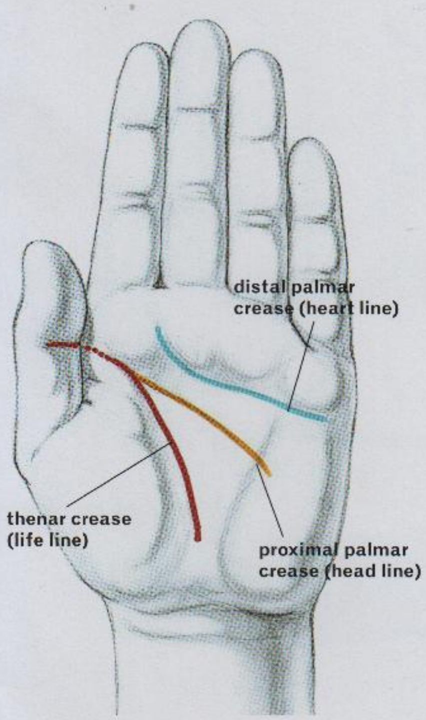
There is a rhythm to the positions of the knuckles and the tips of the fingers. To avoid making hands look too stiff or rigid, always observe the curving alignments of these forms in various poses.

Characteristics of the Skin on the Hand

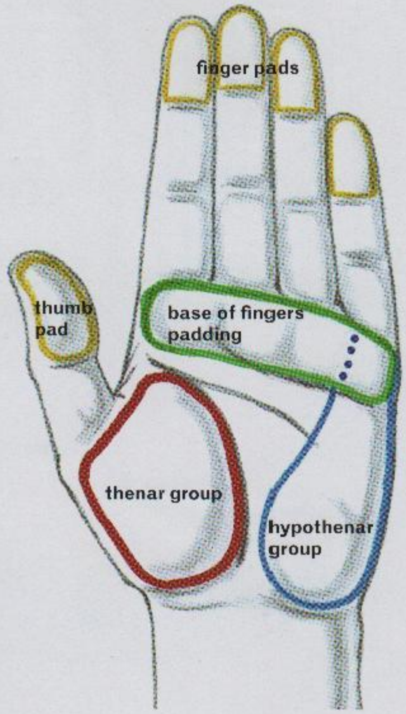
The palmar and dorsal sides of the hand have very different surface characteristics.

On the dorsal side (the back of the hand), the skin is somewhat thin; it is also flexible as it pulls tightly against the bones, tendons, and veins of the hand.

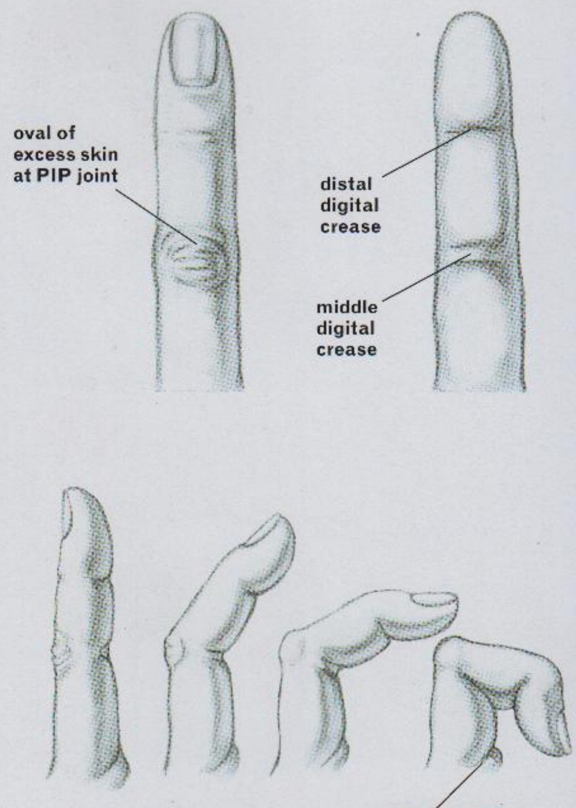
The skin on the palmar side of the hand (called the *palmar skin* or *volar skin*) is thicker and is generally lighter in color than the skin elsewhere on the body except for the soles of the feet. The palmar side is also padded with



Three main creases of palm (left hand)



Palmar pads and muscle group shapes (left hand)



As a finger bends, the creases become more apparent.

SKIN CREASES AND PALMAR PADS OF THE HAND

muscles and fatty layers. The thicker skin and fibrous/fatty padding cushion the hand and enable a more stable grip when handling or grasping objects. The palmar skin is attached to a fibrous tissue called the *palmar aponeurosis* (or *palmar fascia*), which is located in the central triangle of the palm.

Between the bases of the fingers, excess skin attaches to the cylinders of the fingers. This *skin webbing* allows for freer movement when the fingers are spread apart.

SKIN CREASES ON THE PALMAR SIDE

There are many skin creases and folds on the palmar side of the hand. While it is not necessary to try to depict each one, indicating a few of them will give a more realistic quality to the hand. The palm itself has three main skin creases:

- The *thenar crease* (also known as the *fold of the thumb* or, more commonly, the *life line*) curves around the outside of the thenar group. When the thumb is positioned snugly against the side of the palm, the crease of its first joint (IP joint) roughly aligns with the beginning of the thenar crease.
- The *proximal palmar crease* (also known as the *oblique line* or, more commonly, the *head line*) emerges from the top of the thenar crease and travels across the palm in a downward slope.
- The *distal palmar crease* (also known as the *fold of the fingers* or, more commonly, the *heart line*) usually begins below the third finger (middle finger) and travels across the palm toward the outside of the palm.

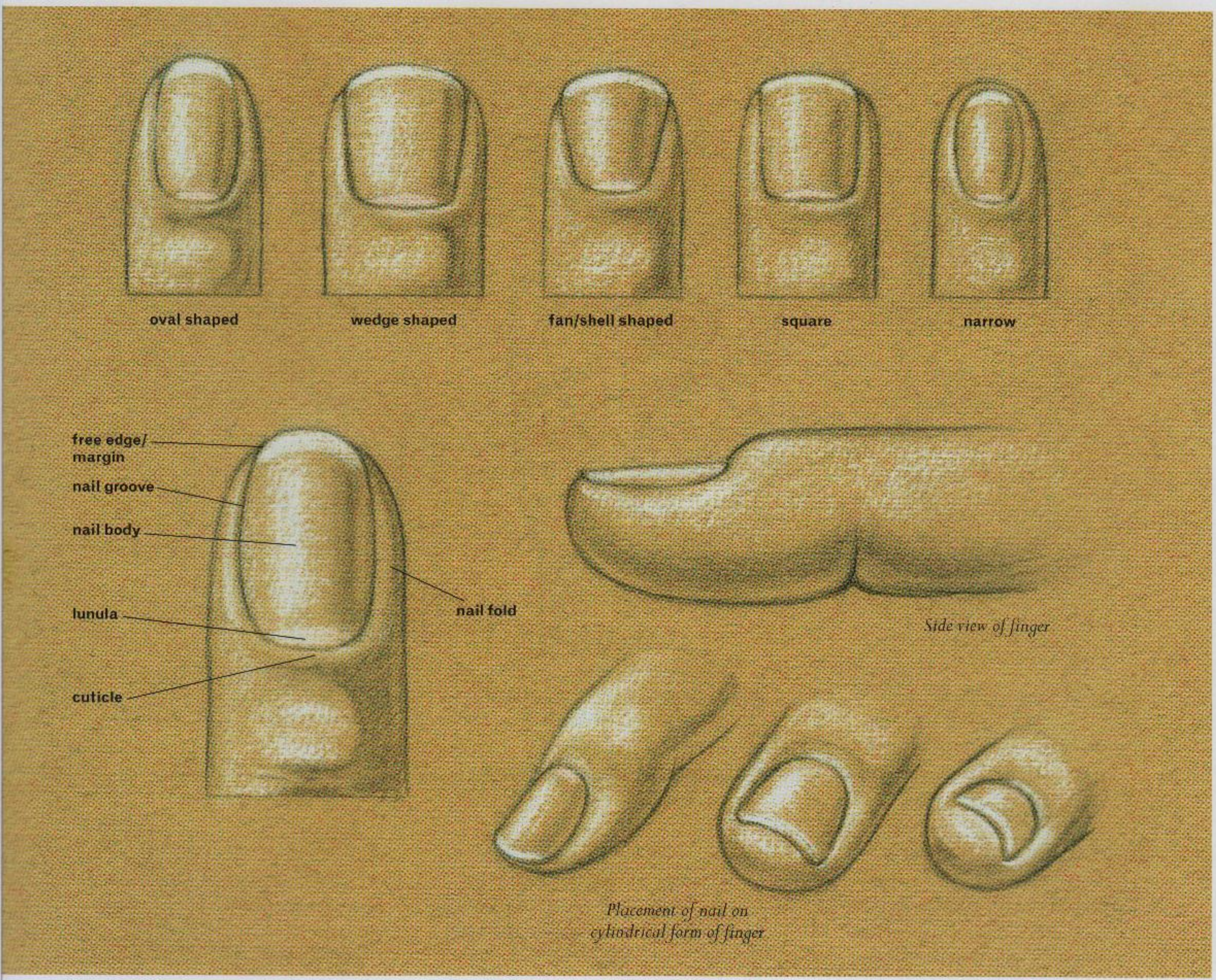
In addition, there are usually two or more delicate lines crossing the wrist area directly under the palm; these are called *wrist creases.*

The creases on the palm are more obvious when the fingers are bending toward the palm, the thumb is bending across the palm in the action of opposition, or the hand is bending at the wrist.

SKIN CREASES ON THE FINGERS

On the palmar side, each of the four fingers is divided into three more or less equal segments. The segments are separated by creases that cross the finger horizontally, indicating the approximately location of the joints. The crease at the DIP joint of a finger is called the *distal digital crease* and generally has one line (but sometimes two lines very close together). At the second joint (PIP joint) is the *middle digital crease*; it typically has two or more creases with a small space between to allow for greater movement in bending the finger. The crease at the base of the finger is called the *proximal digital crease*; it is not directly above the CMC joint because of the excessive palmar fatty tissue in the area just below.

On the dorsal side of the fingers, multiple creases occur at the DIP joint. At the PIP joint is an oval skin mass with multiple creases within it. When the finger bends dynamically at this joint, as in the making of a fist, the excess skin stretches out to accommodate the bending movement of the fingers.



FINGERNAIL CHARACTERISTICS

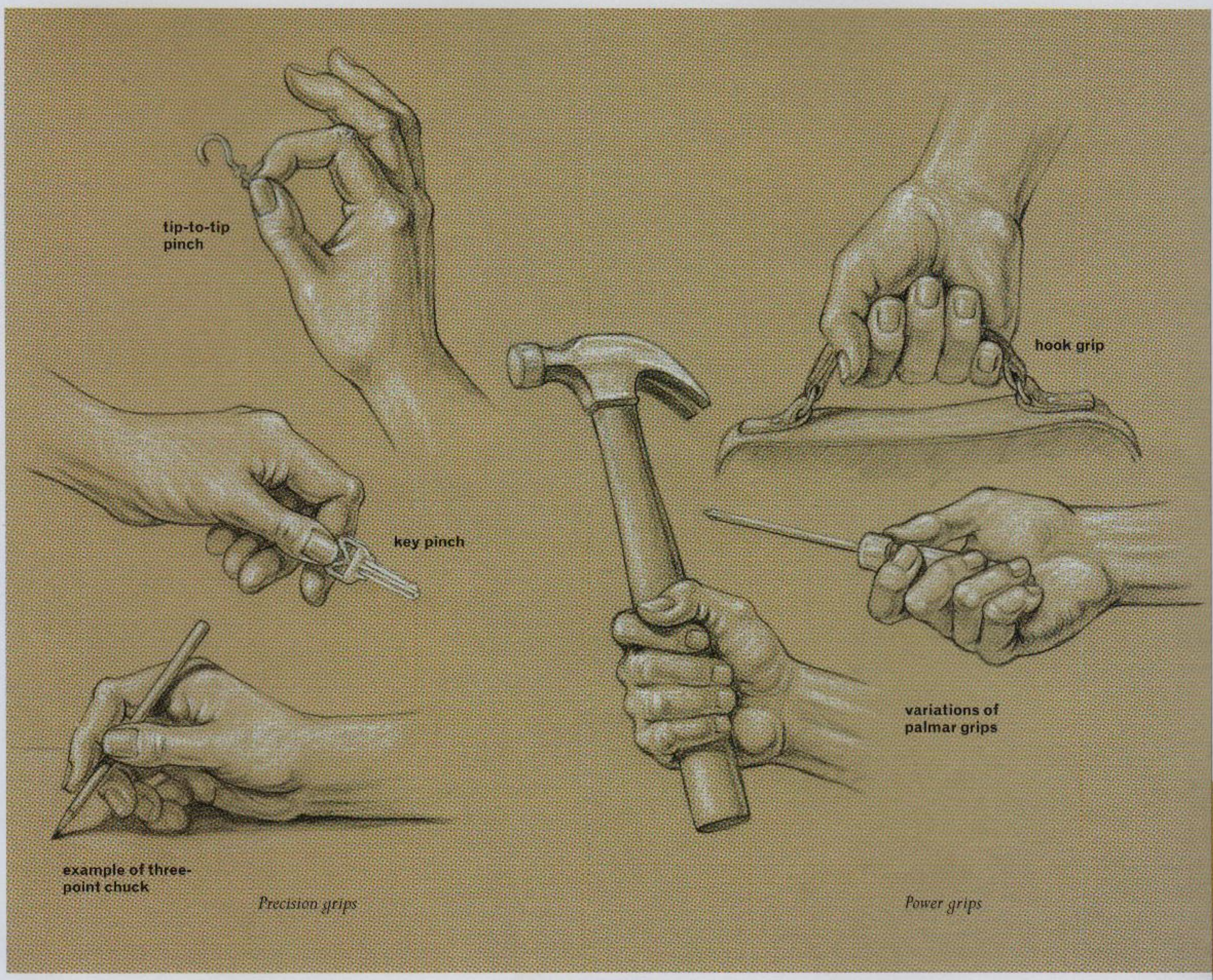
The Fingernails

The fingernails are composed of a material called keratin, which has a shiny, hard surface very different from the texture of the skin on the rest of the finger. The shapes of nails can vary widely, from oval, wedge-shaped, or fan-shaped nails to nails that are squarer. The different components of the nail should be considered when doing highly detailed studies. The *nail body* (or *unquis*) itself does not lie flat but curves as it attaches on the cylindrical shape of the finger. At the base of the fingernail, near the *cuticle* (or *eponychium*), is a pale crescent shape called the *lunula* (from Latin *luna* = moon). The tip of the nail (called the *free edge* or *free margin*) is white or is lighter in color than the nail body. The *nail fold* is the fold of skin that overlaps the side borders of the nail (called the *nail groove*) and appears slightly cylindrical.

Hand Grips

The hand is capable of many complex movements, enabling actions that require meticulous precision, such as playing a musical instrument, as well as actions requiring significant strength, such as wielding construction tools. The hand can produce a variety of different grips when holding objects—a function of the human thumb's extraordinary ability to move in opposition to the fingers, which allows for great dexterity when grasping objects of various shapes and sizes. Your figurative art will benefit from your learning how to depict the hand holding different kinds of objects and your ability to recognize the basic characteristics of the various hand grips.

There are two basic categories of hand grips—the *precision grip* and the *power grip*—with many variations within each group. Precision grips are implemented mainly by the intrinsic muscles of the hand, which allow for delicate control in the movements of the thumb and fingers when grasping smaller objects such as pens or keys. Precision grips usually involve the thumb, index finger, and



HAND GRIPS

middle finger in the areas between these digits' distal joints and the tips of the digits. Some variations on the precision grip are as follows:

- The *tip-to-tip pinch,* in which an object is held between the tips of the index finger and thumb. When posed in a tip-to-tip pinch, the index finger and thumb form an O-shaped negative space between them. This grip is used, for example, when threading a needle or picking up and holding a small, lightweight object, such as a pushpin.
- The *key pinch,* in which an object is held between the thumb pad and the side of the index-finger tip. This grip occurs when holding a key (hence the name), a coin, or a credit card.
- The *three-point chuck,* in which an object is held by the thumb, index finger, and middle finger, usually with the ring and little fingers tucked under toward the palm. This grip is used when holding writing instruments and eating utensils.

The extrinsic muscles of the lower arm, with their long tendons attaching into the hand, enable the various kinds of power grips used when more strength is needed to grasp larger, heavier objects. There are two basic types of power grips, with many variations depending on the size, shape, and weight of the object being grasped and the way the object is being manipulated:

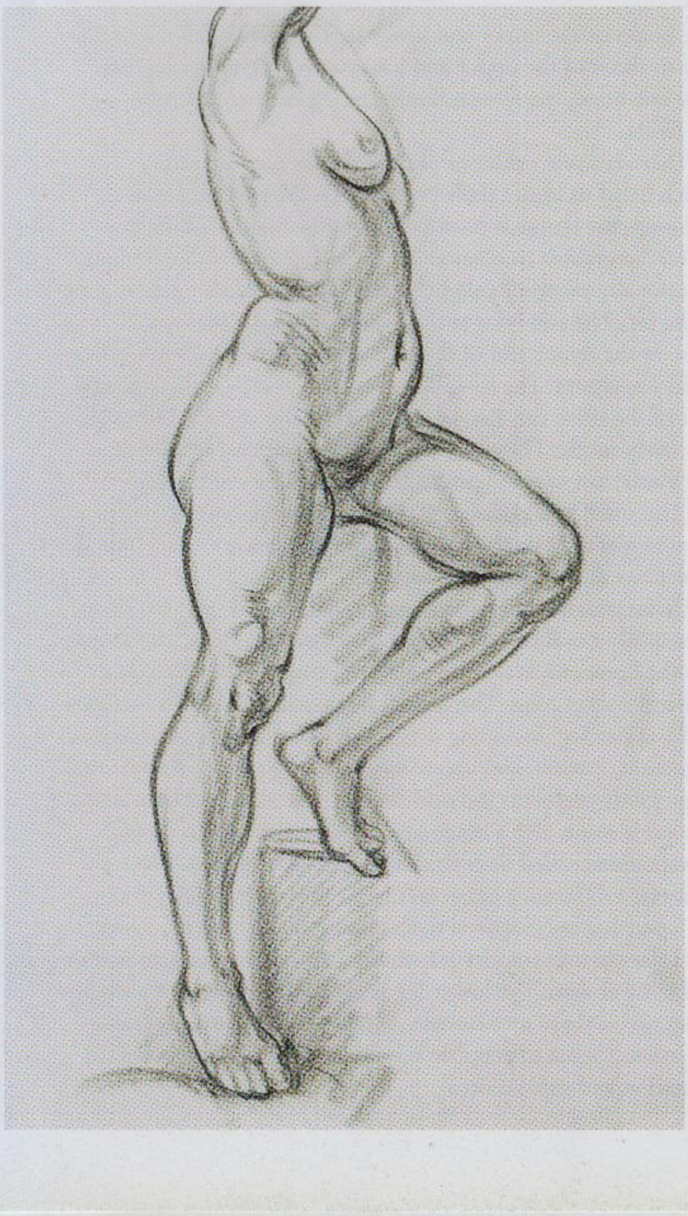
- The *palmar grip,* in which the fingers wrap tightly around an object, holding it firmly against the palm. Palmar grips include grasping a pole, holding a glass, or gripping a small power tool.
- The *hook grip,* in which the fingers are held together in a hooklike formation as they flex around the handle of an object such as a briefcase, bucket, or suitcase handle.

But these represent only a few of the many possible kinds of hand grips. It is essential to observe the structure of the hand as it holds an object to see how the fingers and thumb are positioned and to be aware of the rhythmic alignments of the joints.

Chapter 6 The Leg

Legs come in all sizes and shapes, from the muscular, defined legs of athletes to the stylishly sleek legs of fashion runway models. Since the legs and the pelvis occupy approximately half the height of the standing figure, it is essential to become aware of their basic forms and proportions.

In common usage, the word *leg* refers to the entire lower limb, extending from the hip joint to the ankle joint (and in some uses includes the foot). This differs from anatomical terminology, however, in which the term *leg* refers only to the lower leg (knee joint to ankle joint). In anatomical terminology, the upper leg (hip joint to knee joint) is designated by the term *thigh,* and the entire limb, from hip joint to ankle joint, is referred to as the *lower limb.*

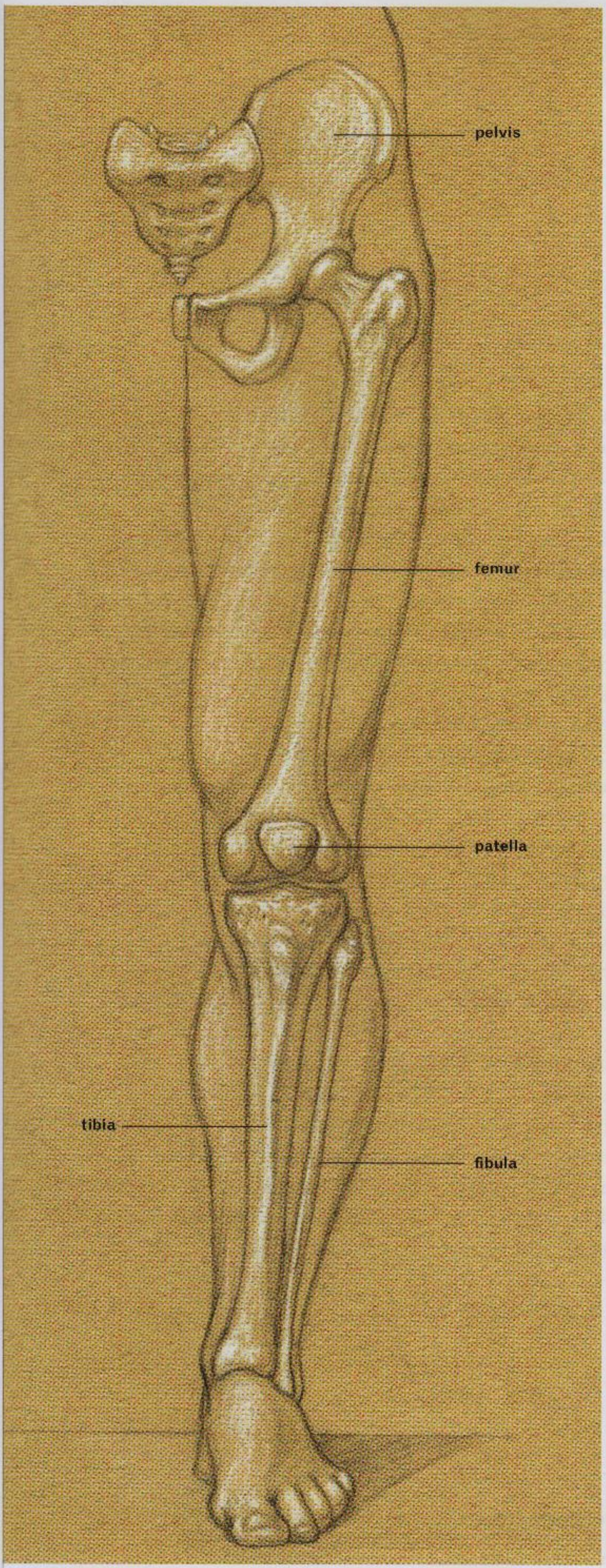


To a layperson, this difference in usage can be confusing. A medical anatomy or kinesiology textbook, for example, might say that a particular muscle "flexes the leg." Reading this, a layperson might think that the whole limb is being flexed from the hip, when in fact it means that the lower leg is being flexed at the knee. Sometimes, however, anatomy books do use clearer language, describing which bone is affected in a particular movement—for example, by saying that a muscle "flexes the tibia" (the main bone in the lower leg). Or they may describe which joint is being activated in the movement, as in "flexes the knee" or "flexes the ankle."

To lessen the possibility of confusion, common terms are used in many of the descriptions that follow, just to keep the information as simple and clear as possible. But anatomical terms are sometimes utilized, so that you will become more familiar with them and eventually learn to connect their meanings with those of the common terms.

Left: **GESTURE POSE—STUDY OF LEGS, SIDE VIEW**

Opposite: **SEATED FIGURE, STUDY OF LEGS, FRONT VIEW**



BONES OF UPPER AND LOWER LEG (LEFT LEG, ANTERIOR VIEW)

The Bones of the Leg

The bones of the upper and lower legs are arranged in a similar way to those of the upper and lower arm. The upper leg has only one bone, the femur; the lower leg has two, the tibia and the fibula.

There is some evidence of these bones near the skin, which helps us locate their presence on the surface form. Although the femur is mostly hidden, the feature of the bone called the greater trochanter (at the upper part of the femur) occasionally protrudes slightly near the skin at the outer region of the hip. The condyles at the lower end of the femur and those at the upper end of the tibia can be seen on a leg bending at the knee joint. The so-called shinbone, which is the anterior part of the tibia, can also be detected on the surface, although it is fairly subtle. The ankle bones (the lower ends of the tibia and fibula) are easily identifiable in most views of the lower leg. The small round shape of the patella (kneecap), although often neglected by artists, is an important feature to include in depictions of the knee joint region.

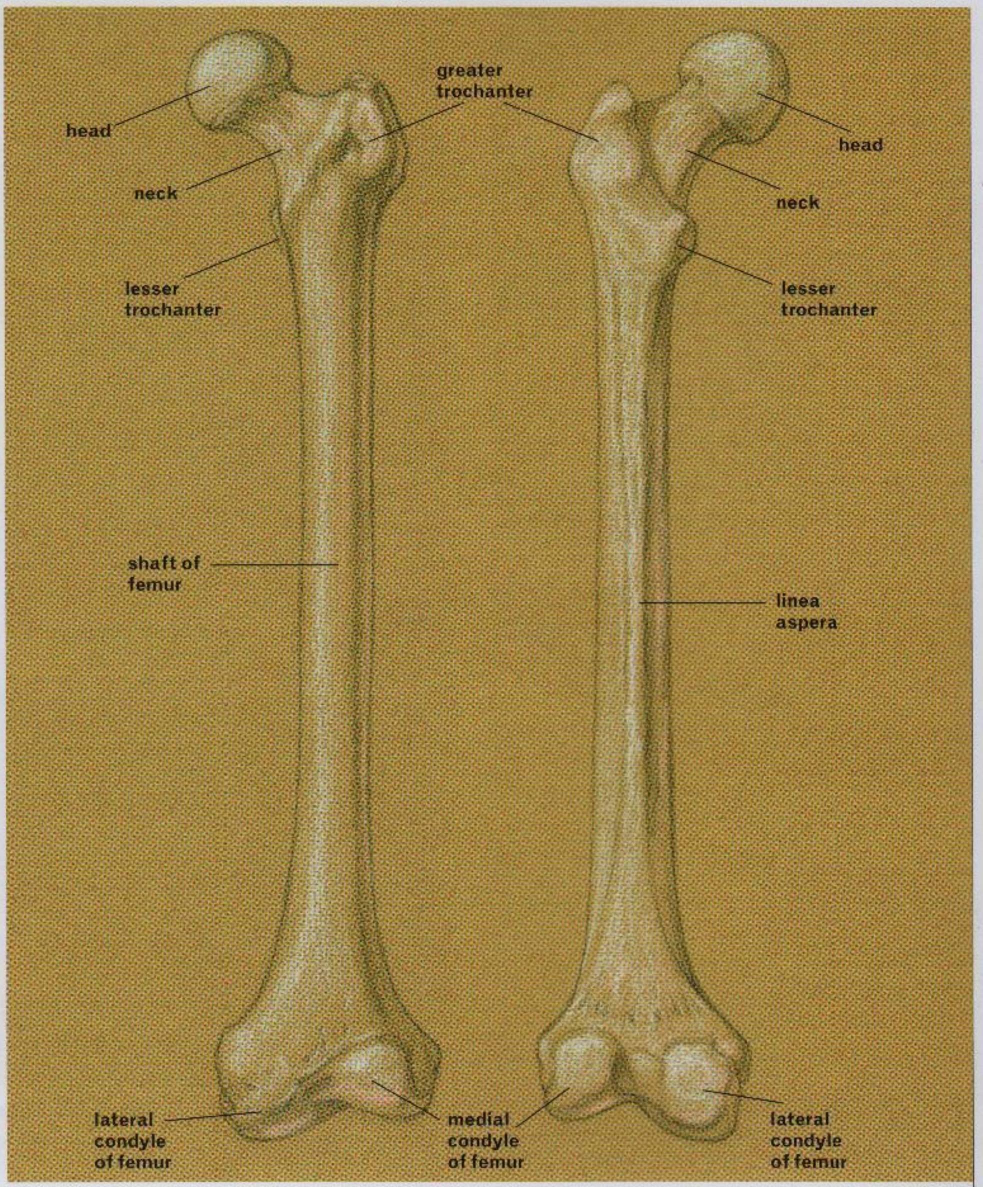
Understanding the movement capabilities of the joints can be helpful in evaluating certain positions of the legs. The femur, like the humerus, articulates with the trunk of the body at a ball-and-socket joint. This allows for a multitude of movements of the upper leg, including rotation, circumduction, abduction, adduction, flexion, and extension. The knee joint, primarily a hinge joint, performs the movements of flexion and extension. The ankle joint, also a hinge joint, moves the foot in up-and-down actions called dorsiflexion and plantar flexion. The only important difference between the movement capabilities of the lower leg as compared to the lower arm is that the lower leg lacks the obvious rotation capabilities (pronation and supination) of the lower arm. The lower leg is capable, however, of a slight variation on these movements, which are called eversion and inversion. (Some experts do consider these to be forms of pronation and supination.)

Femur

PRONOUNCIATION
FEE-mur

ORIGIN OF THE TERM
Latin *femur* = femur, thigh

SYNONYMS
os femoris (TA), thigh bone, upper leg bone



FEMUR (UPPER LEG BONE)
Left: Left femur, anterior view. Right: Left femur, posterior view.

Femur

Of all the bones in the body, the femur—the single bone of the thigh—is the largest and heaviest. The shaft of the femur, encased within the thigh, is not vertically aligned but descends at an angle. The bone's elongated, slightly curving cylindrical shaft is smooth on the anterior side, resembling a thick stalk of bamboo. On the posterior side, a very craggy doubled-lipped ridge called the *linea aspera* runs down nearly the entire length of the shaft. This "rough line" serves as an attachment site for many muscles, including those of the adductor and hamstring groups.

On the upper, lateral end of the femur is a large bony projection called the *greater trochanter,* which serves as an attachment location for the muscles of the gluteal group. The greater trochanter can at times be seen as an obvious bony protrusion on the figure, especially when the hip is tilted, as in a contrapposto pose. (It appears on the side of the supporting, or straight, leg.) When the thigh is slightly abducted from the hip, the fleshy forms of the muscles of the gluteal group conceal the greater trochanter, usually causing an indentation or large dimple near where the greater trochanter would protrude in a contrapposto pose.

A smaller projection, called the *lesser trochanter,* is positioned on the medial side of the femur, opposite and slightly lower than its larger counterpart. It, too, is an attachment site for muscles, but its form cannot be seen of the surface.

From the greater trochanter, a cylindrical strut of bone called the *neck of the femur* projects at an angle toward the pelvis. The neck expands into the golf-ball-shaped *head of the femur,* which articulates with the cuplike socket of the pelvis, called the *acetabulum,* to create the ball-and-socket joint of the hip.

At the lower end of the femur's shaft, the bone flairs out on each side into massive bony projections called the *medial condyle of the femur* and *lateral condyle of the femur.* The condyles help disperse the weight of the body through the limb down to the top of the tibia. They also help stabilize the knee joint and serve as attachment sites for various ligaments and tendons. On the posterior portion of the femur, the condyles become two large "ham hock"–type forms, with a neutral space between them. The thick gastrocnemius muscle (calf muscle) anchors on these bulbous shapes, which is why the condyles are not seen on the surface of the back of the leg. The front and side portions of the condyles can, however, be seen on the surface; especially when the knee is bending, they take on a more angular appearance in the knee region or show as obvious bony protrusions.

Tibia

PRONOUNCIATION
TIB-ee-ah

ORIGIN OF THE TERM
Latin *tibia* = shin bone

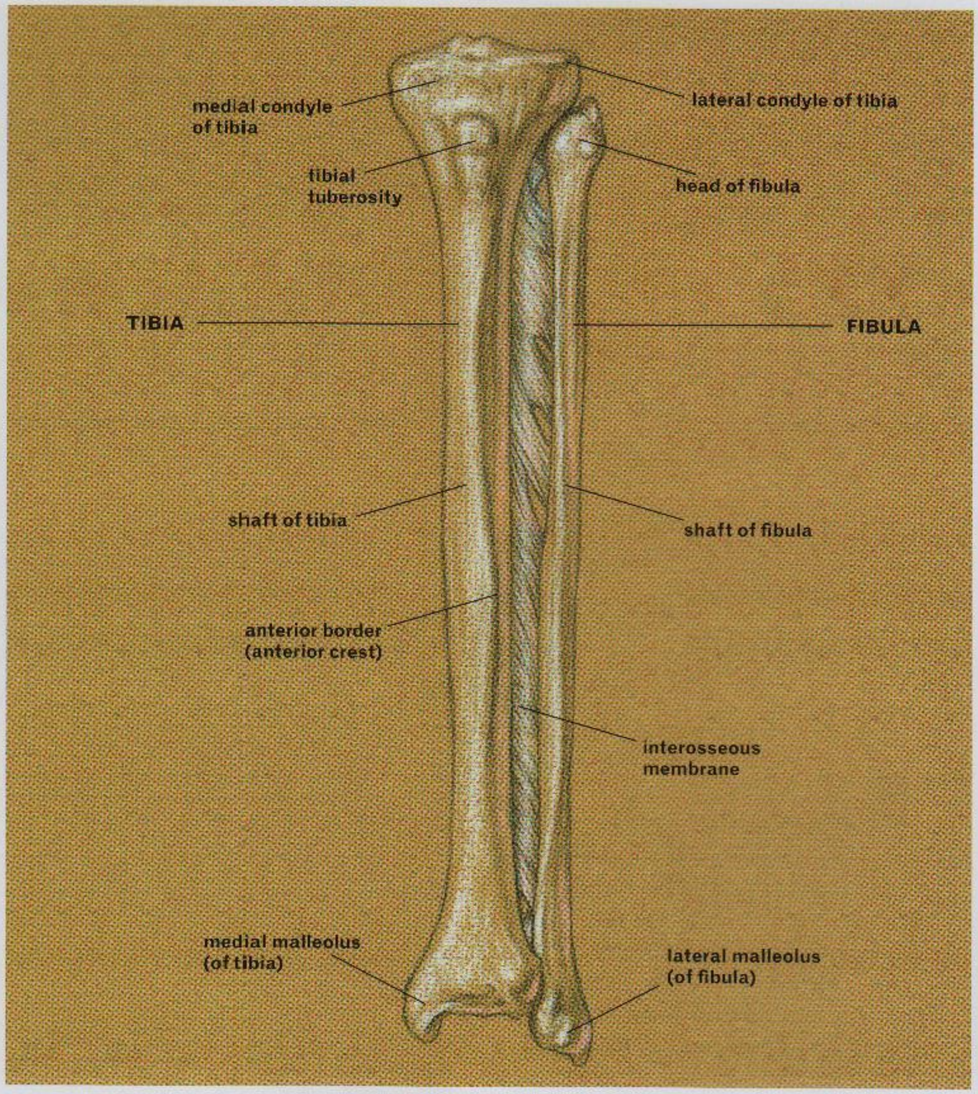
SYNONYMS
shin bone, shin,
lower leg bone

Fibula

PRONOUNCIATION
FIB-yoo-lah

ORIGIN OF THE TERM
Latin *fibula* = a clasp, buckle, or brooch

SYNONYMS
calf bone, peroneal bone,
splint bone



TIBIA AND FIBULA (LOWER LEG BONES)
Lower left leg, anterior view

Tibia and Fibula

The lower leg (or, to use anatomical terminology, the leg) has two bones. The larger bone is the tibia. The shaft of the tibia is triangular and has a medial surface, lateral surface, and posterior surface. At the front of the shaft, a sharp edge called the *anterior border* (or *anterior crest*) divides the medial and lateral surfaces. This is the area usually referred to as the shin (or shinbone). The anterior border descends in a gentle curve down most of the length of the shaft and is very close to the skin. The medial surface of the tibia has hardly any muscle or padding attached to it, and its structure can therefore be seen beneath the skin as the bone sweeps downward toward the inner ankle.

The lower end of the tibia forms the bony landmark of the inner ankle, called the *medial malleolus* in anatomical terminology but commonly referred to as the anklebone. The inner ankle is larger and is located higher up than the outer ankle (formed by the fibula). The surface under the lower end of the tibia articulates with the talus tarsal bone of the foot.

At the upper end of the tibia, the bone flairs out on each side into the *lateral condyle of the tibia* and the *medial condyle of the tibia,* which articulate with the condyles of the femur. Slightly below and between the tibia condyles, an obvious bony protrusion that occurs on the surface form; this knobby form, called the *tibial tuberosity,* is an attachment site for the thick ligament band of the patella (kneecap).

The fibula is a very slender bone positioned on the lateral side of the lower leg next to the tibia. The shaft of the fibula is triangular, but it twists in a slight spiral on its vertical descent. The *head of the fibula* can be detected on the surface as a marble-sized projection on the side of the leg near the knee joint. At the lower end of the fibula is the formation of the outer anklebone, called the *lateral malleolus.* The lateral malleolus is usually more slender and is positioned lower than the broader inner ankle of the tibia.

The fibula functions somewhat like a flying buttress, helping to stabilize the ankle joint; it also serves as an attachment site for various muscles and fibrous connective-tissue structures.

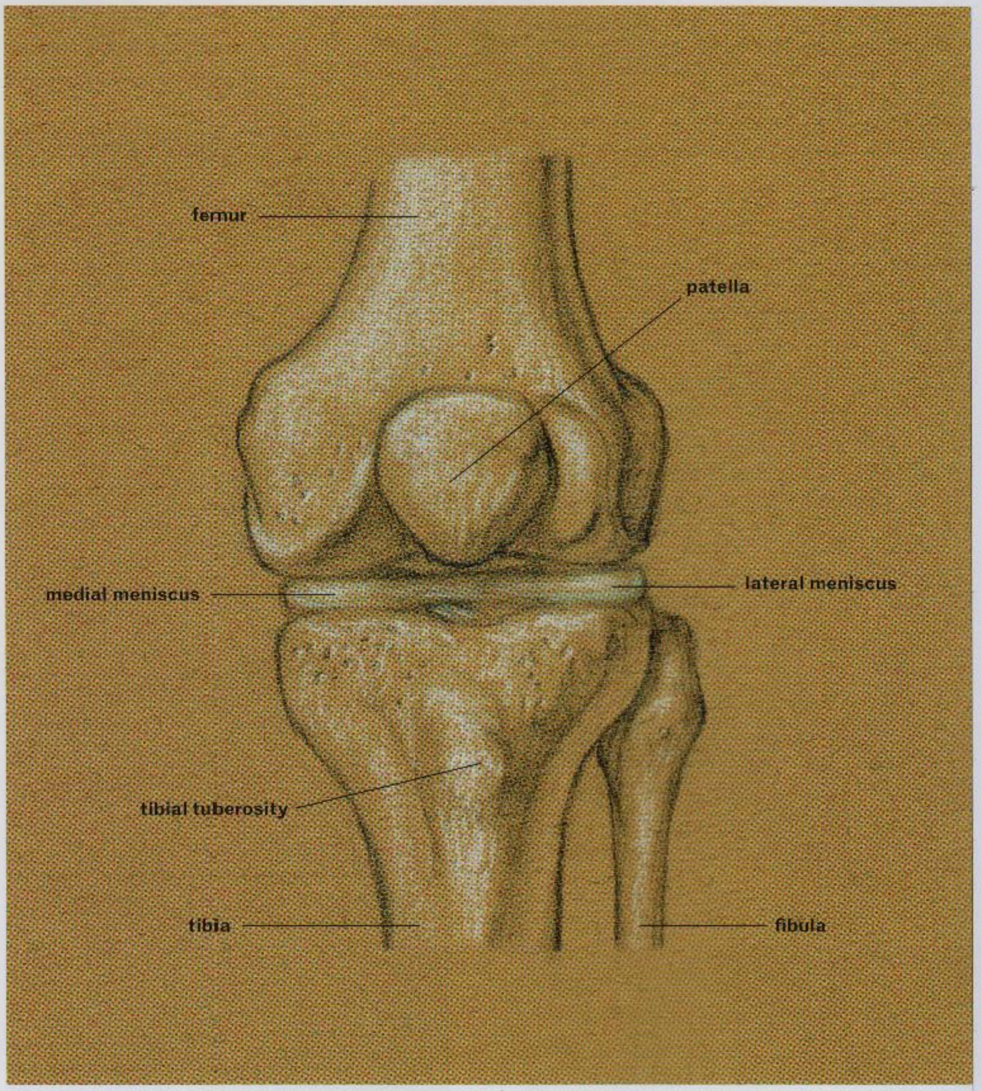
The *interosseous membrane* is a connective tissue that attaches between the shafts of the tibia and fibula bones, forming a fibrous joint with very minimal movement. The membrane helps stabilize the tibia and fibula alongside each other and provides an additional attachment surface for various muscles of the lower leg.

Patella

PRONOUNCIATION
pah-TELL-ah

ORIGIN OF THE TERM
Latin *patella* = a small plate

SYNONYMS
knee cap, knee pan,
bone of knee, knee



KNEE JOINT (WITH PATELLA)
Left-leg knee joint, anterior view

Knee Joint

Figurative artists sometimes oversimplify the knee region. But it is worth taking the time to understand its structure and mechanisms. If you do so, you will be able to construct the knee more convincingly when depicting the legs.

The knee joint is the largest synovial joint. The joint is essentially a hinge joint enabling the movements of flexion and extension, but the knee also allows other, subtler movements, which involve the condyles of the femur rolling and gliding over the condyles of the tibia, with minimal rotation.

The knee joint includes the *condyles of the femur* and, positioned directly below them, the *condyles of the tibia*. The *patella* (kneecap) is positioned anteriorly on an extended leg, in the center of the femur condyles and with its lower end aligned at the transition between the femur and tibia.

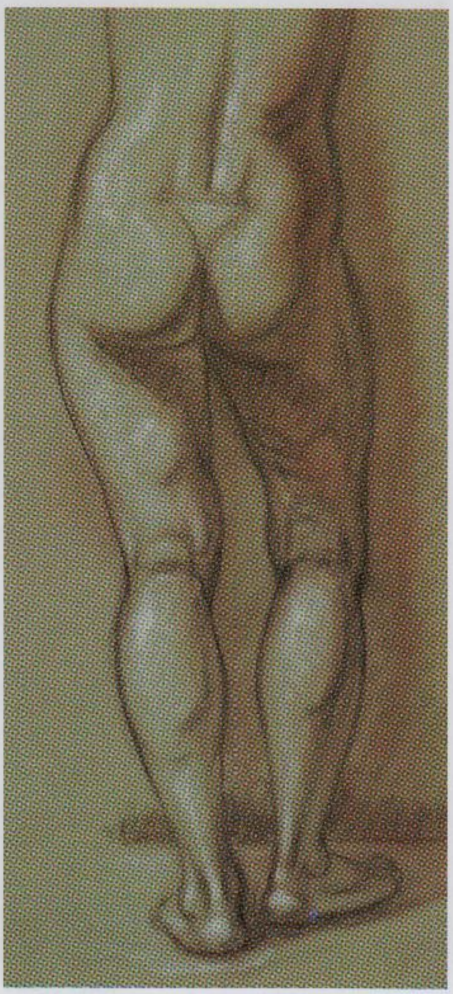
The patella is a somewhat triangular bone that is flat on the front with an oblique ledge on the upper portion. The apex is at the lower end, although this slightly pointy feature of the bone appears more rounded on the surface form. The patella may at first seem like an insignificant bone, but its small form is an important player in the knee joint region. Two similarly round forms appear at the front of the knee region on a straightened leg: The top form is the kneecap; the form below is composed of fatty tissue. Since the patella is hard bone, the highlights and tones on the kneecap are more pronounced than those on the fatty pad, which should be depicted with softer tones.

Positioned on top of the medial and lateral condyles of the tibia are two crescent-shaped fibrocartilages, called the *medial meniscus* and the *lateral meniscus*, which serve as shock absorbers for the knee joint.

The Muscles of the Leg

The muscular, dynamic shapes of the legs have always fascinated artists. The ancient Egyptians usually depicted the legs with the feet firmly planted on the ground, making the legs seem like strong pillars connected to the earth. Later, the ancient Greek artists explored a more relaxed position of the legs on the standing figure; known as the contrapposto (meaning "counterpoise"), this position has the knee of one leg slightly bent while the other remains straight. The contrapposto gives an elegant quality to the upper and lower legs, and its many variations have influenced countless artists. Renaissance and Baroque artists were enthralled by it, using the stance for many of their painted and sculpted figures. (A prime example is Michelangelo's *David*.) Artists from the Renaissance on have also found that an understanding of the dynamics of the leg's muscles helps define the shape of the legs and contributes to the richness of their forms.

There are many variations on the anatomical classification of muscles of the upper leg and lower leg. They may be categorized according to their location (in anterior, posterior, medial, or lateral regions or compartments) or according to their action or function (as extensors, flexors, or adductors). Leg muscles are also sometimes grouped together by their more common names, including the hamstring group, the quadriceps group, and the gluteal group.



BACK VIEW OF LEGS

Most medical anatomy sources treat the muscles of the lower leg as individual muscles rather than as groups, although their functions (extensors or flexors) and locations (anterior, posterior, or lateral) are acknowledged. The gastrocnemius and soleus muscles are treated both individually and as a group (the triceps surae). The peroneus longus and peroneus brevis muscles, located on the lateral side of the lower leg, are sometimes known as the peroneal group. Because it can be confusing to try to remember these various groupings, lists of the groups, their locations, and the individual muscles belonging to each are provided below.

The Muscles of the Upper Leg

Most medical anatomy books divide the thigh into three compartments: the *anterior compartment*, the *posterior compartment*, and the *medial compartment*. The compartments are separated from each other by fascia partitions called the *intermuscular septa*.

In general, the muscles within each compartment are identified as a group, with each group associated with a particular kind of movement. There is one important exception: the sartorius muscle, which is a muscle of the anterior compartment but which plays a part in a number of different actions. The groups associated with the three compartments of the thigh, and the individual muscles within each, are as follows. Note that, in two cases, the groups have alternate names: The *quadriceps group* is also known as the *extensor group*, and the *hamstring group* is also known as the *flexor group*.

Anterior Compartment of Thigh
Quadriceps group / extensor group
Vastus lateralis
Vastus medialis
Vastus intermedius
Rectus femoris

Sartorius [does not belong to any group]

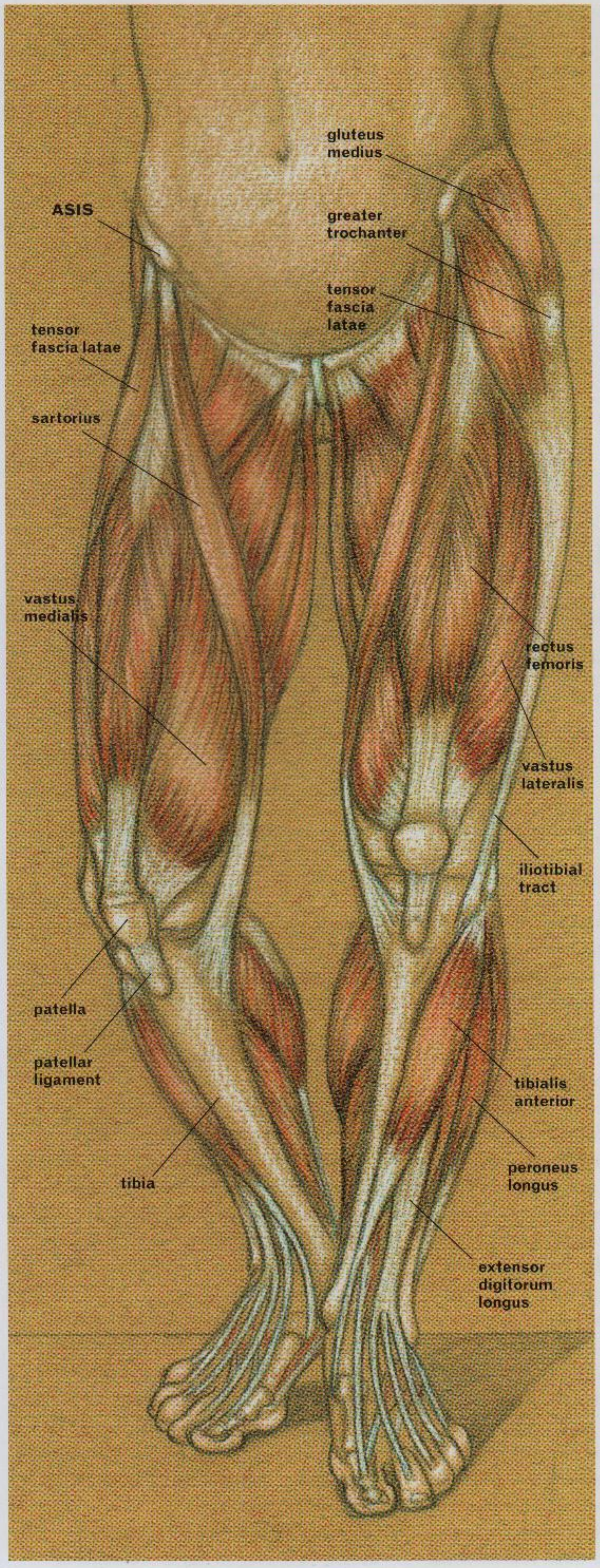
Medial Compartment of Thigh
Adductor group
Adductor magnus
Adductor longus
Adductor brevis
Pectineus
Gracilis

Posterior Compartment of Thigh
Hamstring group / flexor group
Biceps femoris
Semitendinosus
Semimembranosus

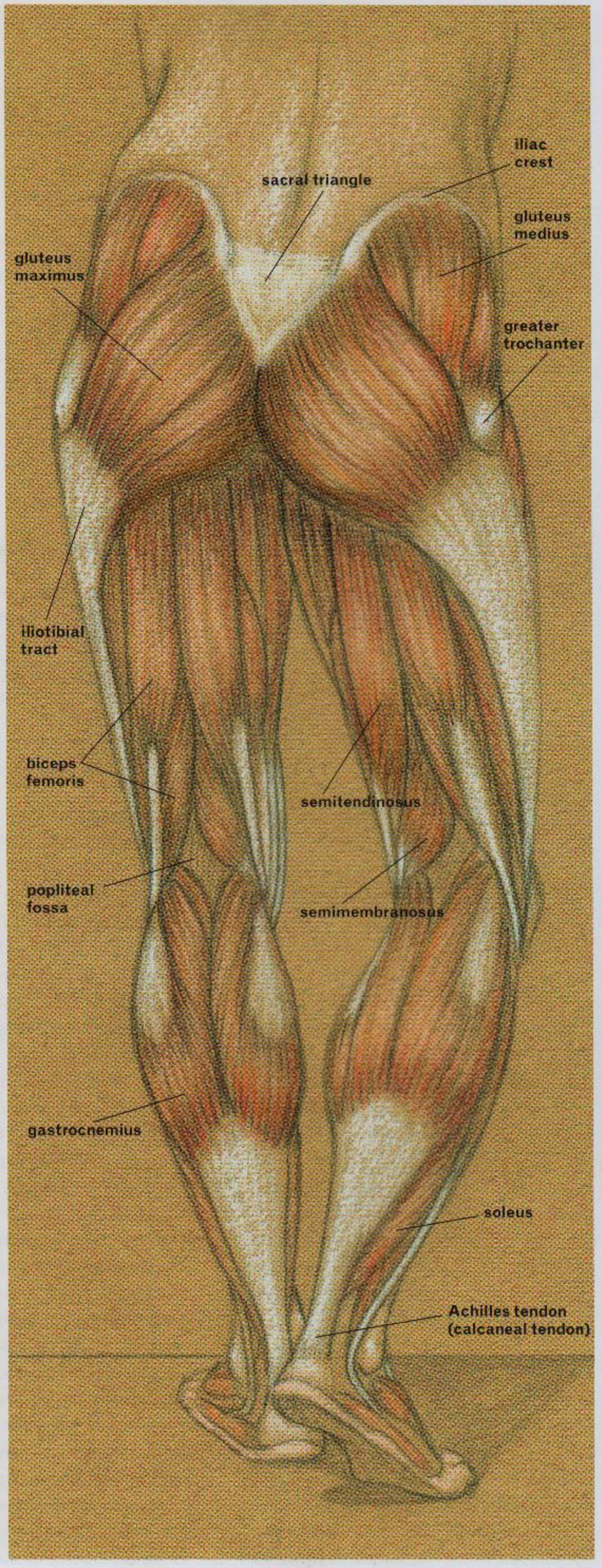
In addition to these three groups, the muscles of the upper leg include the *gluteal group*. Although the gluteal group muscles do not belong, anatomically, to the compartments of the upper leg, these muscles are involved in moving the thigh and are included in this chapter for that reason. This group of muscles occupies the pelvis region, yet their presence is important when indicating the muscular forms of the upper leg. The gluteal group is a transitional muscle group, because they are positioned between the torso and upper leg. (Note that the gluteal group muscles are often included in muscle charts of the torso as well as in anatomical charts of the upper and lower leg.)

The muscles of the gluteal group are as follows:

Gluteal region
Gluteal group
Gluteus maximus
Gluteus medius
Tensor fascia latae



MUSCLES OF THE FRONT OF THE LEG



MUSCLES OF THE BACK OF THE LEG

Quadriceps Group

PRONOUNCIATION
KWAHD-rih-seps

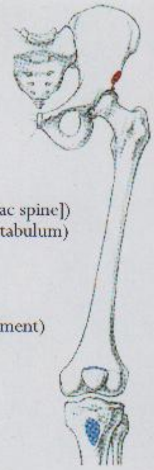
ORIGIN OF THE TERM
Latin *quad* = four + *caput* = head

SYNONYMS
musculus quadriceps femoris (TA), compartimentum femoris anterius (TA), compartimentum femoris extensorum (TA), quadriceps extensor femoris, anterior compartment of thigh, extensor compartment of thigh, quadriceps, quadriceps femoris, triceps femoralis, quadriceps extensor cruris, upper thigh muscles, four-headed muscle of femur (thigh), "quads"

Rectus femoris

ORIGIN
- pelvis (AIIS [anterior inferior iliac spine])
- pelvis (directly above rim of acetabulum)

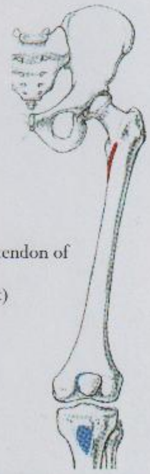
INSERTION
- patella (by common tendon of quadriceps)
- tibial tuberosity (by patellar ligament)



Vastus medialis

ORIGIN
- linea aspera of femur (medial lip)
- near lesser trochanter

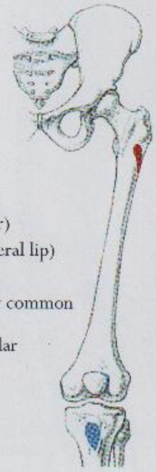
INSERTION
- patella (medial border) by common tendon of quadriceps
- tibial tuberosity (by patellar ligament)



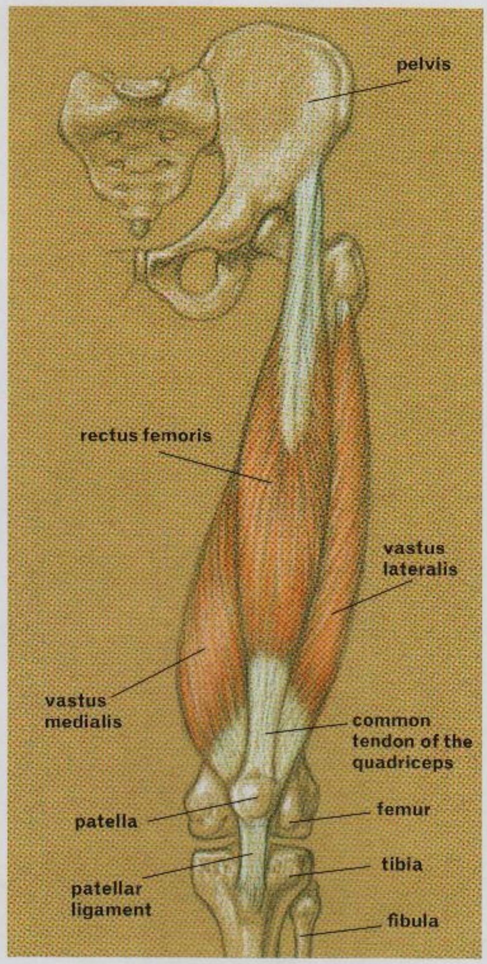
Vastus lateralis

ORIGIN
- greater trochanter (femur)
- linea aspera of femur (lateral lip)

INSERTION
- patella (lateral border) by common tendon of quadriceps
- tibial tuberosity (by patellar ligament)



QUADRICEPS GROUP—MUSCLE ATTACHMENTS
Anterior view of upper left leg. (Vastus intermedius not shown.)



QUADRICEPS GROUP (ANTERIOR VIEW, UPPER LEFT LEG)

Quadriceps Group

The quadriceps group (more traditionally known as the *quadriceps femoris group*) creates a visually dynamic form occupying most of the front portion of the thigh. Considered together, the muscles of the quadriceps group have four heads (which is how the group gets its name, since *quadriceps* means "four heads" in Latin), although only three of these heads are usually visible on the surface form. The muscles of the quadriceps are the *vastus lateralis,* the *vastus medialis,* the *vastus intermedius,* and the *rectus femoris.* It is the vastus intermedius that is hidden on the surface form, being completely covered by the rectus femoris.

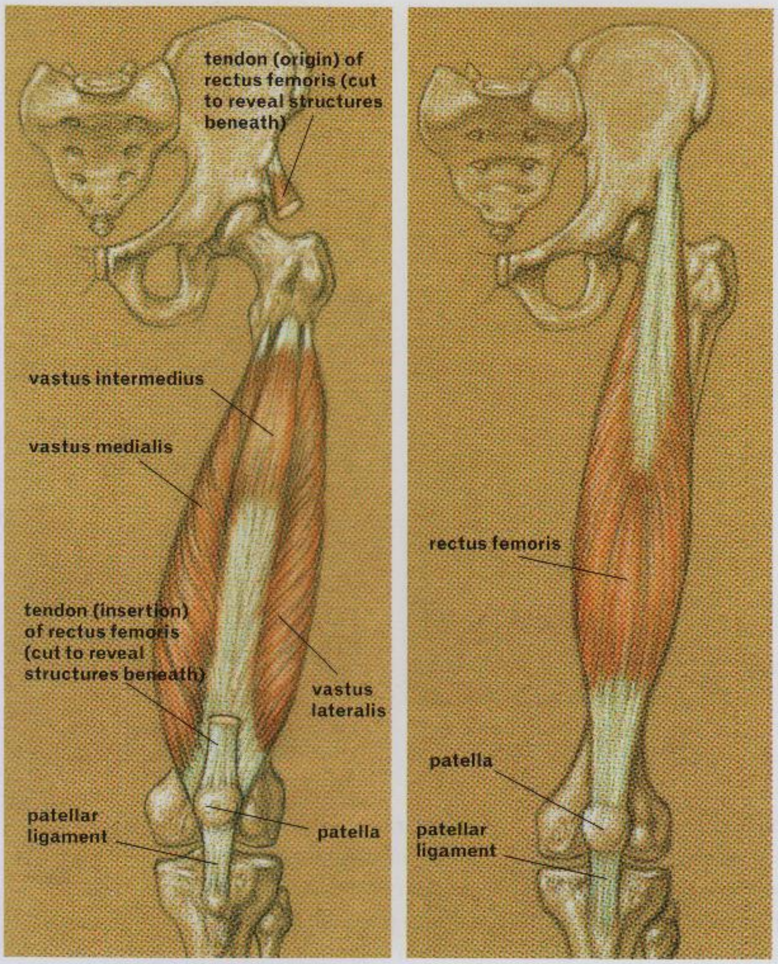
The quadriceps muscles generally register as a cylindrical mass on a living model, with perhaps only the outer head of the vastus lateralis and inner heads of the vastus medialis protruding on the surface. These are the rich bulges that occur in the muscles near the tendon of insertion into the knee cap. On athletic body types, however, the three heads can be clearly seen as three distinct shapes. When the knee is bent, the outer and inner quad heads of the vastus lateralis and vastus medialis become stretched, and the condyles of the femur and tibia are more easily seen, producing large bony forms near the patella.

The three vastus muscles (lateralis, medialis, and intermedius) all originate on the femur, while the fourth muscle of the quadriceps (the rectus femoris) originates on the pelvis. As they travel down the thigh, all four muscles eventually share the same tendon of insertion, which attaches into the patella (kneecap). This tendon creates a somewhat flat, neutral surface form above the patella, contrasting with the richer forms of the heads of the quadriceps. When the quads contract, the heads pull upward and become more prominent; when the quads relax, the heads drop slightly and become less visible. The *patellar ligament* is a strap of fibrous connective tissue that attaches on the patella (kneecap) and inserts into the tibial tuberosity of the tibia. It is essential when depicting the quadriceps group to include the patella, the patellar ligament, and the tibial tuberosity. All of these forms are interconnected as part of the quadriceps group.

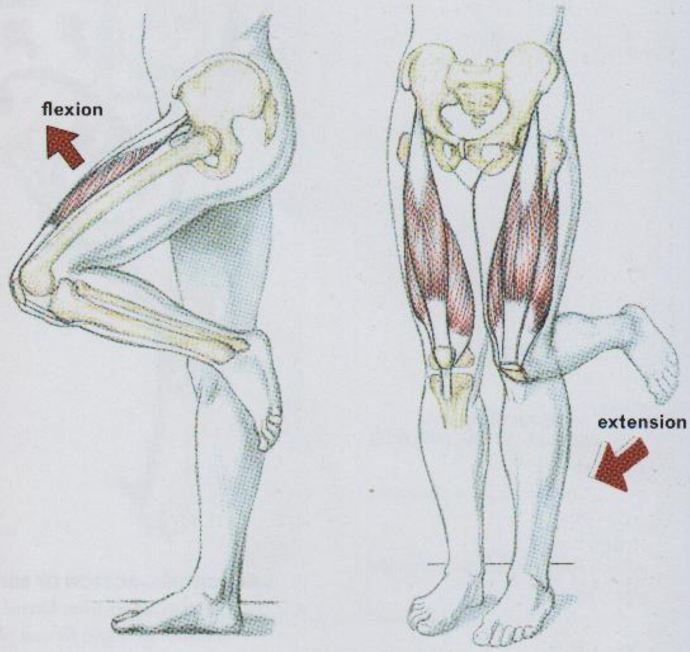
ACTION OF THE MUSCLES

The quadriceps is a powerful group of upper thigh muscles that mainly functions to extend the lower leg by straightening it from a bent position at the knee. This muscle group is activated when climbing stairs, doing squats, and getting up from a chair. The quads play a major role in walking, running, and jumping.

The vastus lateralis and vastus intermedius both assist in the extension of the lower leg (tibia and fibula) at the knee joint. The upper fibers of the vastus medialis also help extend the leg at knee joint, while the lower fibers help stabilize the patella. The rectus femoris flexes or bends the upper leg from the hip joint. This muscle is activated in the swing action of the leg in the movements of kicking, walking, and running.



FOUR HEADS OF QUADRICEPS GROUP (ANTERIOR VIEW, UPPER LEFT LEG)
Left: Vastus muscles. Right: Rectus femoris.



Rectus femoris muscle: flexion of thigh at hip joint (lateral view of left leg)

All quadriceps muscles: extension of lower leg at knee joint (anterior three-quarters view)

QUADRICEPS GROUP—ACTION OF MUSCLES

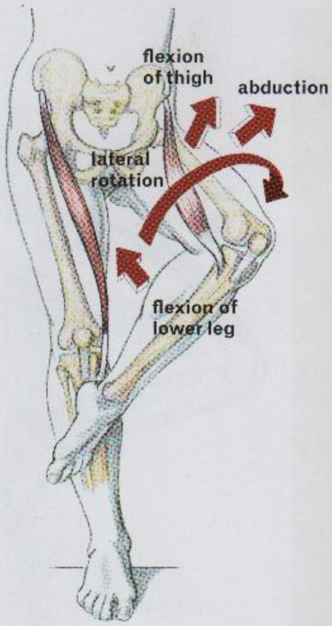
Muscles of the Quadriceps Group

REGION	DESCRIPTION AND CHARACTERISTICS	ORIGIN OF TERM	SYNONYMS
Vastus Lateralis (VAS-tus laa-ter-AL-iss)	The largest of the quadriceps, the vastus lateralis is a pennate muscle positioned on the outer part of the upper leg. It begins on the femur, near the base of the greater trochanter and along the linea aspera on the posterior portion of the femur. The muscle fibers swing around obliquely from the back of the femur to insert into the lateral border of the patella by the common tendon of the quadriceps.	Latin *vastus* = of large extent + *lateralis* of the side	musculus vastus lateralis (TA), vastus externus
Vastus Medialis (VAS-tus mee-dee-AL-iss)	The vastus medialis is positioned on the inner, or medial, part of the upper leg. It begins on the linea aspera along the posterior region of the femur. The muscular fibers wrap around from the back of the femur. The long upper fibers tend to be more vertical, while the lower fibers are more oblique as they travel around to the anterior part of the femur. The fibers attach into the medial border of the patella by the common tendon of the quadriceps.	Latin *vastus* = of large extent + *medialis* of the middle	musculus vastus medialis (TA), vastus internus
Vastus Intermedius (VAS-tus in-ter-ME-de-us)	The vastus intermedius is positioned between the vastus lateralis and the vastus medialis. It forms the muscular foundation, or base, for the rectus femoris muscle, which attaches over it, obscuring the vastus intermedius from view.	Latin *vastus* = of large extent + *intermedius* = in between	musculus vastus intermedius, crureus
Rectus Femoris (RECK-tus FEM-o-riss *or* RECK-tus FEM-mor-iss *or* RECK-tus fem-MORE-iss)	The fourth quadriceps muscle, the rectus femoris, begins not on the femur but on the pelvis, below the ASIS landmark. It is a bipennate muscle. Positioned on the anterior part of the femur, it conceals the vastus intermedius muscle beneath. The sartorius muscle covers the upper portion of the rectus femoris.	Latin *rectus* = straight + *femoris* = of the femur (or thigh)	musculus rectus femoris (TA), kicking muscle, straight muscle of the femur

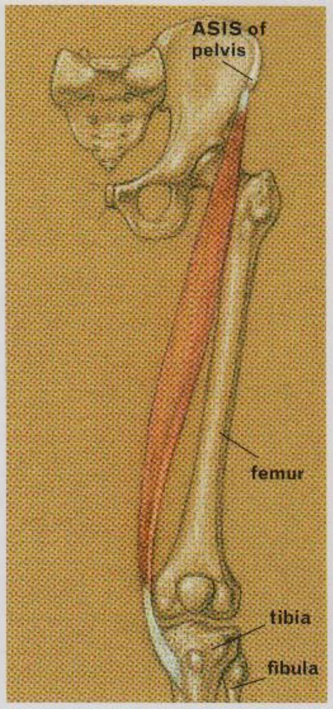
SARTORIUS—MUSCLE ATTACHMENTS

ORIGIN
- ASIS (anterior superior iliac spine) of pelvis

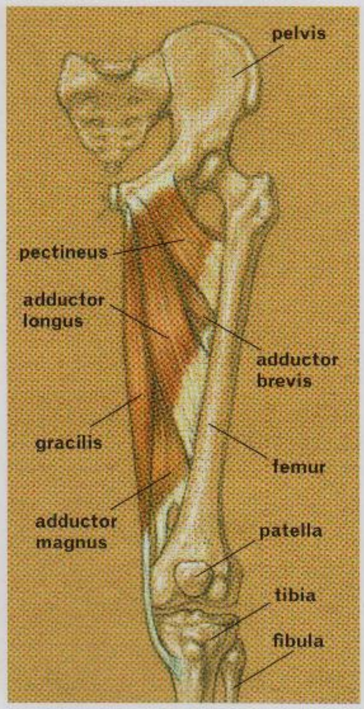
INSERTION
- tibia (medial surface, below medial condyle)



SARTORIUS—ACTION OF MUSCLE
Flexion, abduction, lateral rotation of thigh; flexion of lower leg (anterior view)



SARTORIUS (ANTERIOR VIEW, UPPER LEFT LEG)



ADDUCTOR GROUP (ANTERIOR VIEW, UPPER LEFT LEG AND PELVIS)

Sartorius

The straplike sartorius muscle is the longest muscle of the body. It begins near the ASIS of the pelvis and travels obliquely downward between the quadriceps group and the adductor group. It swings around the medial condyles of the femur and tibia to insert on the tibia.

The muscle is usually seen as a furrow, which is enhanced by tone. Only on very athletic people, such as runners, is the straplike shape of the muscle seen on the surface form. This muscle also gives the upper leg a rhythmic sense movement, joining the tendons of the gracilis (of the adductor group) and semitendinosus (of the hamstring group) to form a rich bulbous mass on the inner part of the knee region where it inserts into the tibia. The combination of tendon insertions on the tibia in this region forms a webbed structure called the *pes anserinus,* or *goosefoot.* (See page 225 for more on this structure.)

ACTION OF THE MUSCLE

The sartorius is also called the tailor's muscle because it helps other muscles to bring the lower leg into a cross-legged position—a position commonly adopted by tailors, who in the days before sewing machines would spread fabric across their laps when sewing and mending.

The sartorius performs many different movements, including the flexion (bending) of the thigh at the hip joint; the lateral rotation of the thigh at the hip joint, in which the upper leg is rotated slightly outward; the abduction of the thigh at the hip joint, which moves the upper leg away from the body; and the flexion of the lower leg at the knee joint. It is activated in soccer kicks, when crossing the knee in a seated position, and in certain ballet movements as well as various dance steps in which the leg is bent at the knee as the knee rolls outward.

Sartorius

PRONOUNCIATION
sar-TOR-ee-us

ORIGIN OF THE TERM
sartor = tailor

SYNONYMS
musculus sartorius (TA), tailor's muscle

Adductor Group

PRONOUNCIATION
ah-DUCK-tor

ORIGIN OF THE TERM
Latin *adductus* = brought forward

SYNONYMS
compartimentum femoris adductorum (TA), compartimentum femoris mediale (TA), adductor compartment of thigh, medial compartment of thigh

Adductor Group

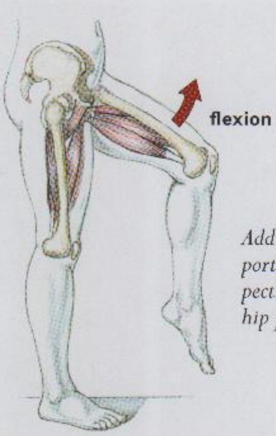
Five muscles belong to the adductor group: the *adductor magnus,* the *adductor longus,* the *adductor brevis,* the *pectineus,* and the *gracilis.* Together, they form the inner (medial) portion of the thigh. They originate at various points on the pubic bone and ischium region of the pelvis. Four of the muscles insert along the posterior surface of the femur; the exception is the gracilis, which inserts on the tibia.

On the surface form, the muscles of the adductor group appear as a single muscular mass between the sartorius muscle and the fold of the groin (inguinal ligament) of the pelvis region.

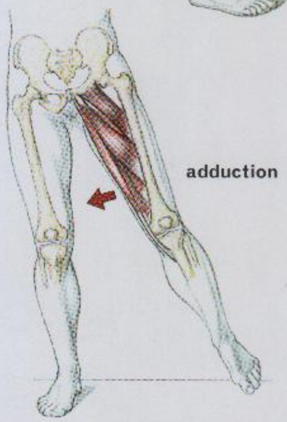
ACTION OF THE MUSCLES

As the name of the adductor group indicates, these muscles primarily adduct the upper leg at the hip joint, pulling the abducted upper leg back toward the midline of the body. The adductor longus, the pectineus, and the upper portion of the adductor magnus also participate in the flexion of the thigh at the hip joint. The lower portion of the adductor magnus assists in the extension of the thigh at the hip joint.

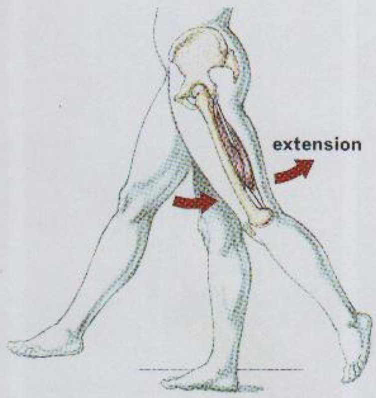
The muscle group is activated in certain movements in sports such as horseback riding, skiing, and soccer; when maintaining equilibrium on a balance board; and, more mundanely, when bringing the outside leg in or out of a car and when holding the knees tightly together. The adductor muscles also help stabilize the pelvis.



Adductor magnus (upper portion), adductor longus, and pectineus: flexion of thigh at hip joint (lateral view)



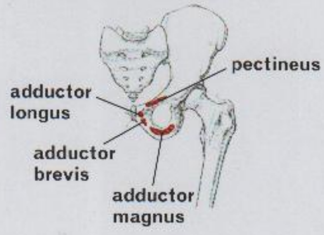
All adductor muscles: adduction of thigh at hip joint (anterior view)



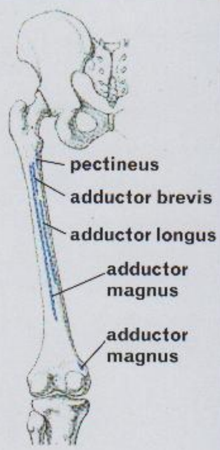
Adductor magnus (lower portion): extension of thigh at hip joint (lateral view)

ADDUCTOR GROUP—ACTION OF MUSCLES

Gracilis (anterior view of pelvis and upper left leg)



Adductor muscles—origins (anterior view of pelvis and upper left leg)



Adductor muscles—insertions (posterior view of pelvis and upper left leg)

ADDUCTOR GROUP—MUSCLE ATTACHMENTS

ORIGIN (ADDUCTOR MAGNUS)
- pelvis (ischial tuberosity, inferior ramus of pubis, inferior ramus of ischium)

INSERTION (ADDUCTOR MAGNUS)
- femur (along whole length of linea aspera)

ORIGIN (ADDUCTOR LONGUS)
- pelvis (near pubic symphysis)

INSERTION (ADDUCTOR LONGUS)
- femur (linea aspera, medial lip)

ORIGIN (ADDUCTOR BREVIS)
- pelvis (inferior ramus of pelvis)

INSERTION (ADDUCTOR BREVIS)
- femur (linea aspera, upper part)

ORIGIN (PECTINEUS)
- pelvis (superior ramus of pubis)

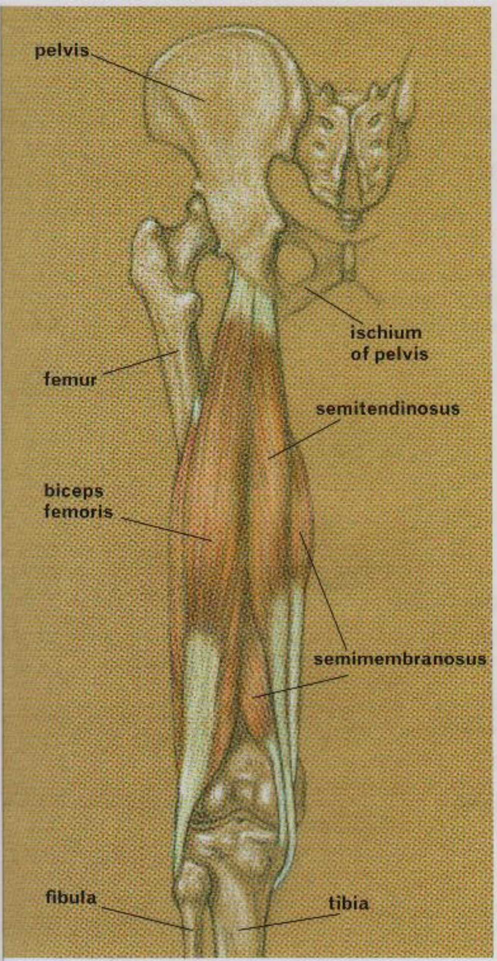
INSERTION (PECTINEUS)
- femur (between lesser trochanter and linea aspera)

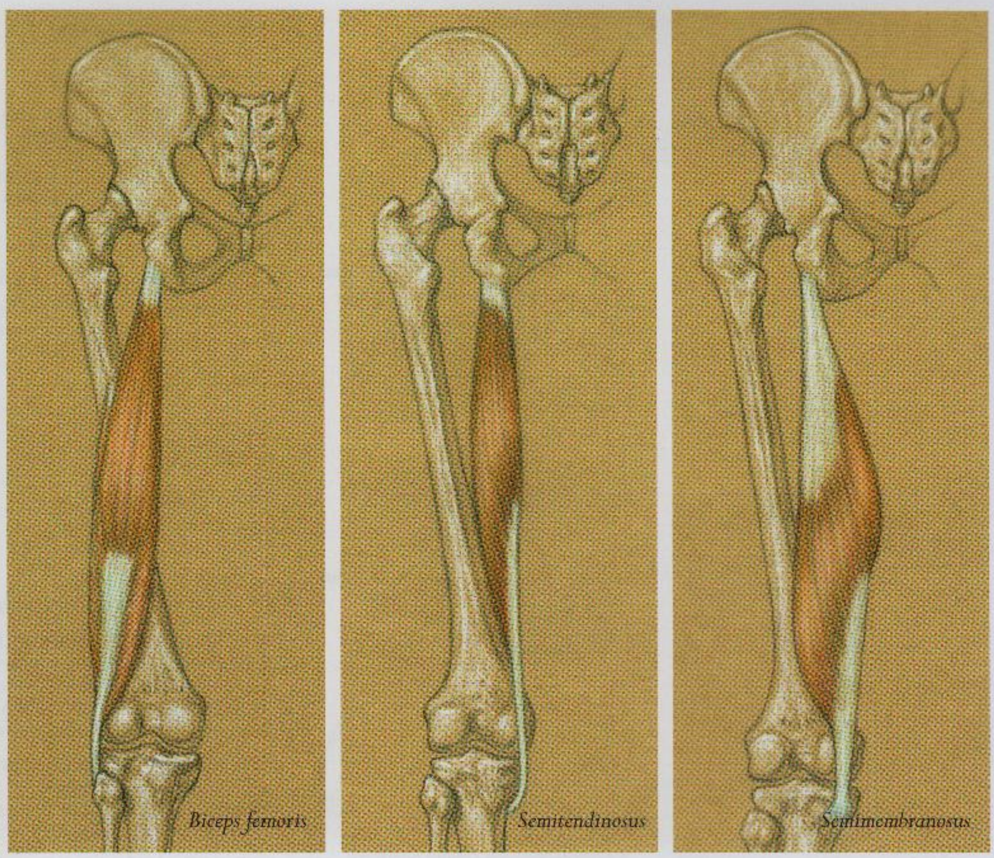
ORIGIN (GRACILIS)
- pelvis (ischium, near pubic symphysis, inferior ramus of pubis)

INSERTION (GRACILIS)
- tibia (anterior surface, below medial condyle)

Muscles of the Adductor Group

REGION	DESCRIPTION AND CHARACTERISTICS	ORIGIN OF THE TERM	SYNONYMS
Adductor Magnus (ah-DUCK-tor MAG-nuss)	The largest and deepest muscle of the adductor group, the adductor magnus is mostly covered by the adductor longus and adductor brevis in the front and by the gracilis on the inner part of the thigh. Posteriorly, it is covered by the semitendinosus and semimembranosus muscles of the hamstring group. Even though the muscle is not visible on the surface form, its powerful, massive form contributes to the shape of the inner thigh.	Latin *adductus* = brought forward + *magnus* = great	musculus adductor magnus (TA), great adductor muscle
Adductor Longus (ah-DUCK-tor LON-gus)	A large, fan-shaped muscle positioned over the middle portion of the adductor magnus, the adductor longus sometimes appears as a triangular or round mass near the medial part of the thigh.	Latin *adductus* = brought forward + *longus* = long	musculus adductor longus (TA), long adductor of the thigh
Adductor Brevis (ah-DUCK-tor BREH-viss *or* ah-DUCK-tor BREV-iss)	Because it is positioned underneath the adductor longus and pectineus muscles, the adductor brevis can be hard to see on the surface form.	Latin *adductus* = brought forward + *brevis* = short	musculus adductor brevis (TA), short adductor of the thigh
Pectineus (peck-TIH-nee-us *or* peck-TIN-ee-us)	The pectineus is the shortest muscle of the adductor group. The sartorius hides the lower part of the pectineus, and the upper part is mostly covered by large vessels of the thigh and by fatty tissue.	Latin *pecten* = a comb	musculus pectineus (TA)
Gracilis (GRAHS-ih-liss *or* GRAH-suh-liss *or* GRISS-sih-liss *or* grah-SIL-iss)	An elongated, straplike band of muscle positioned on the medial part of the thigh, the gracilis attaches to the pubic bone near the pubic symphysis and vertically descends to attach on the medial surface of the tibia. This is the area in which the sartorius and semitendinosus muscles also insert, and all three muscles contribute to the goosefoot form of the inner knee region. (See page 225 for more on this structure.)	Latin *gracilis* = slender	musculus gracilis (TA)





Above: **THE THREE MUSCLES OF THE HAMSTRING GROUP (POSTERIOR VIEW, UPPER LEFT LEG AND PELVIS)**

Left: **HAMSTRING GROUP (POSTERIOR VIEW, UPPER LEFT LEG)**

Hamstring Group

The hamstring group, on the posterior side of the femur, consists of three muscles: the *biceps femoris,* the *semitendinosus,* and the *semimembranosus.* The biceps femoris is located on the lateral portion of the back of the thigh, while the semitendinosus and the semimembranosus are both located on the medial portion of the back of the thigh, one positioned overtop the other. The origins of the hamstring muscles, on the ischial tuberosity of the pelvis, are concealed by the gluteus maximus on the surface form.

The hamstring group usually is seen as a cylindrical mass on the back of the thigh. As they travel toward their insertion points, the tendons of the hamstrings separate into the rounded, cordlike forms that run along either side of the knee. The tendons become more noticeable when the knee is bent, causing a hollow or deep pit above the back crease of the knee area. This hollow space is called the *popliteal space* or, more commonly, the *ham.* When the leg is straight, the hollow is fleshed out, mainly with fatty tissue.

There are two possible origins of the term *hamstrings.* It may have originated in the practice of smoking or curing thighs of pork (hams) by hanging them by their tendons. Or it may derive from the fact that the hollow space at the back of the

Hamstring Group

SYNONYMS

compartimentum femoris posterius (TA), compartimentum femoris flexorum (TA), flexor compartment of thigh, hamstring muscles, posterior femoral region, posterior thigh muscles, muscles of the posterior aspect of the thigh, posterior compartment of the thigh, muscles of the back of the thigh

Biceps femoris (posterior view of pelvis and upper left leg)

Semitendinosus—origin (posterior view of pelvis)

Semitendinosus—insertion (anterior view of knee joint)

Semimembranosus (posterior view of pelvis and upper left leg)

HAMSTRING GROUP—MUSCLE ATTACHMENTS

ORIGIN (BICEPS FEMORIS, LONG HEAD)
- pelvis (ischial tuberosity)

ORIGIN (BICEPS FEMORIS, SHORT HEAD)
- femur (linea aspera, lateral lip)

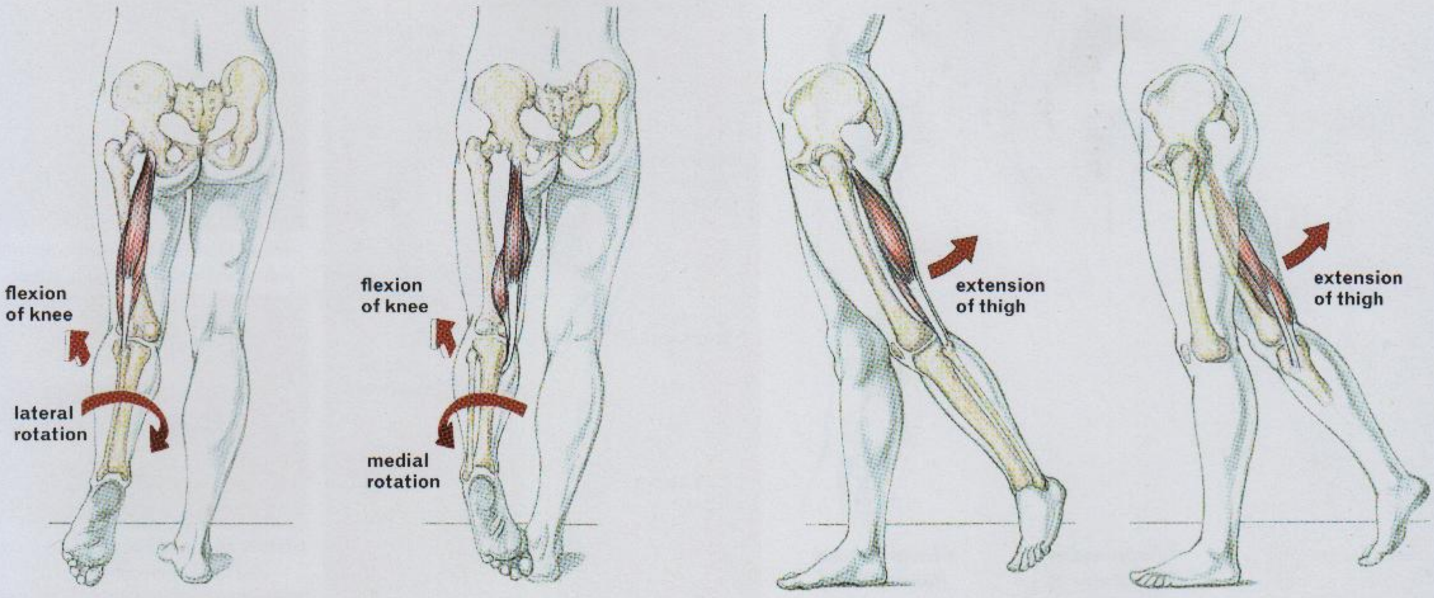
INSERTION (BICEPS FEMORIS)
- head of fibula

ORIGIN (SEMITENDINOSUS)
- pelvis (ischial tuberosity)

INSERTION (SEMITENDINOSUS)
- tibia (medial surface, below medial condyle)

ORIGIN (SEMIMEMBRANOSUS)
- pelvis (ischial tuberosity)

INSERTION (SEMIMEMBRANOSUS)
- tibia (medial condyle, posterior surface)



Biceps femoris: flexion of knee, lateral rotation of lower leg (posterior view)

Semimembranosus and semitendinosus: flexion of knee, medial rotation of lower leg (posterior view)

Biceps femoris: extension of thigh at hip joint (lateral view)

Semimembranosus and semitendinosus: extension of thigh at hip joint (lateral view)

HAMSTRING GROUP—ACTION OF MUSCLES

knee—commonly called the ham—is defined by the "strings" of these muscles' tendons running along both sides.

ACTION OF THE MUSCLES

The hamstring group is the prime mover in the action of extending (straightening) the thigh at the hip joint and flexing (bending) the leg at the knee joint. All the hamstrings are involved in those two movements. The semitendinosus and semimembranosus muscles also produce the medial rotation of the tibia on the femur (when knee is flexed). The biceps femoris is also responsible for the lateral rotation of the tibia (when the knee is flexed). Also, these muscles are activated in the ballet movement known as arabesque, which is a dramatic hyperextension of a straight leg.

The hamstrings are activated in walking, jumping, and running.

Muscles of the Hamstring Group

MUSCLE	DESCRIPTION AND CHARACTERISTICS	ORIGIN OF THE TERM	SYNONYMS
Biceps Femoris (BI-seps FEM-oh-riss *or* BI-seps FEM-mor-iss *or* BI-seps fem-MORE-iss)	Occupying the medial half of the posterior portion of the thigh, the biceps femoris is a two-headed muscle but usually appears as a single muscular shape. One head attaches on the ischial tuberosity of the pelvis, sharing a common tendon of origin with the semitendinosus. The second head attaches on the femur along the linea aspera. The origin of the second head is hidden by the fleshy fibers of the first head. The tendon of insertion is a long, cordlike structure that attaches onto the head of the fibula.	Latin *bi* = two + *caput* = head + *femoris* = pertaining to the femur, thigh	musculus biceps femoris (TA), biceps flexor cruris, two-headed muscle of the femur
Semitendinosus (SEM-ee-TEN-dih-NO-suss *or* seh-MY-ten-din-OH-suss)	Positioned over the semimembranosus on the medial side of the posterior portion of the thigh, the semitendinosus attaches to the ischial tuberosity of the pelvis, sharing a common tendon of origin with the biceps femoris. Its muscle fibers have a spindle-shaped quality; its elongated, cordlike tendon descends to insert below the medial condyle of the tibia. This tendon also groups with the tendons of the sartorius and gracilis to form the fanned-out tendinous insertion known as the goosefoot. (See page 225 for more on this structure.)	Latin *semi* = half + *tendere* = to stretch or extend (pertaining to tendons or sinews)	musculus semitendinosus (TA)
Semimembranosus (SEM-ee-mem-brah-NO-suss *or* seh-MY-mem-bran-OH-suss)	The semimembranosus is a broad, thick muscle. Portions of the semimembranosus project slightly beyond the sides of the semitendinosus, which is positioned over it. Sometimes it forms a soft bulge near the popliteal fossa (a diamond-shaped space located at the back of the knee joint between the tendons of the hamstring muscles) when the leg is straight.	Latin *semi* = half + *membrana* = thin skin, membrane, parchment	musculus semimembranosus (TA)

Tensor fascia latae (lateral view of upper left leg)

ORIGIN
- ASIS (anterior superior iliac spine of pelvis)
- iliac crest (anterior part)

INSERTION
- iliotibial band (upper portion)

Gluteus medius (lateral view of upper left leg)

ORIGIN
- pelvis (outer surface of ilium)

INSERTION
- greater trochanter (lateral surface)

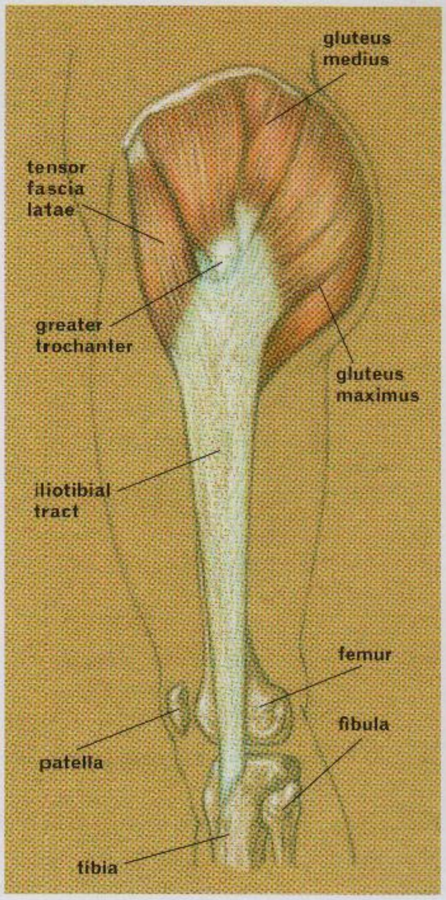
Gluteus maximus (lateral view of upper left leg)

ORIGIN
- iliac crest (posterior quarter)
- sacrum (lateral edges)
- coccyx (lateral edges)

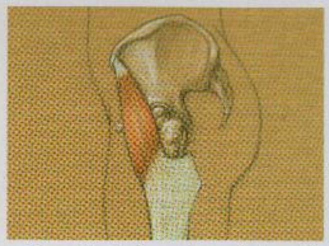
INSERTION (UPPER PORTION)
- iliotibial band

INSERTION (LOWER PORTION)
- femur

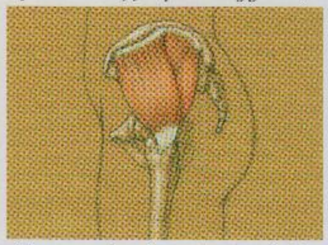
GLUTEAL GROUP—MUSCLE ATTACHMENTS



GLUTEAL GROUP (LATERAL VIEW, UPPER LEFT LEG AND PELVIS)



Tensor fascia latae (lateral view of pelvis and upper portion of femur)



Gluteus medius (lateral view of pelvis and upper portion of femur)

Gluteus maximus (posterior view of pelvis and upper portion of femur)

THE THREE MUSCLES OF THE GLUTEAL GROUP

Gluteal Group

Three muscles of the gluteal group can be seen on the surface form: the *tensor fascia latae,* the *gluteus medius,* and the *gluteus maximus.* A fourth gluteal muscle, the *gluteus minimus,* is completely covered by the gluteus medius and therefore is not shown on the accompanying drawings.

The muscles occupy the pelvic region, covering most of the pelvis (aside from the sacrum and iliac crest) from back and side views. The gluteus maximus and tensor fascia muscular fibers merge into the *iliotibial tract* (see below) near the region of the greater trochanter of the femur. This band travels straight down the outside of the upper leg, overlapping the vastus lateralis of the quads and inserting into the lateral condyle of the tibia.

In athletic people, the three main muscles of the gluteal group are often distinctly evident on the surface form, but fatty tissue can mask the general shape of the glutes in some people, giving the pelvic region a softer, rounder quality.

ILIOTIBIAL TRACT

The upper leg and pelvis have various fascias, which are thin, fibrous, connective-tissue sheaths that cover the muscle groups. Located on the upper thigh is a fascia called the *fascia lata,* which is much like a snugly fitting body stocking. The iliotibial tract (or *iliotibial band*) is the thicker part of the fascia lata and is located on the lateral side of the thigh. The muscles fibers of the tensor fascia latae and the gluteus maximus insert into the iliotibial tract, at which point it is regarded as a flattened, elongated tendon of the gluteal muscles. Because the iliotibial tract acts like a tense rubber band as it inserts into the lateral condyle of the femur, it slightly flattens the rich contour of the outer surface of the vastus lateralis muscle. A slight furrow occurs on its back border, dividing the hamstring group from the quadriceps group.

CLEFT OF BUTTOCKS/GLUTEAL FOLD

On the posterior view of the standing figure, a vertical cleft of the buttocks begins immediately below the sacrum, dividing the two gluteus maximus muscles from one another. From the cleft, the muscles swing away from one another; at the lower border of each, a horizontal skin fold, called the gluteal fold, appears. The gluteal fold is a band of fascia that supports and contains fatty tissue, which pads the inner and outer borders of the

Gluteal Group

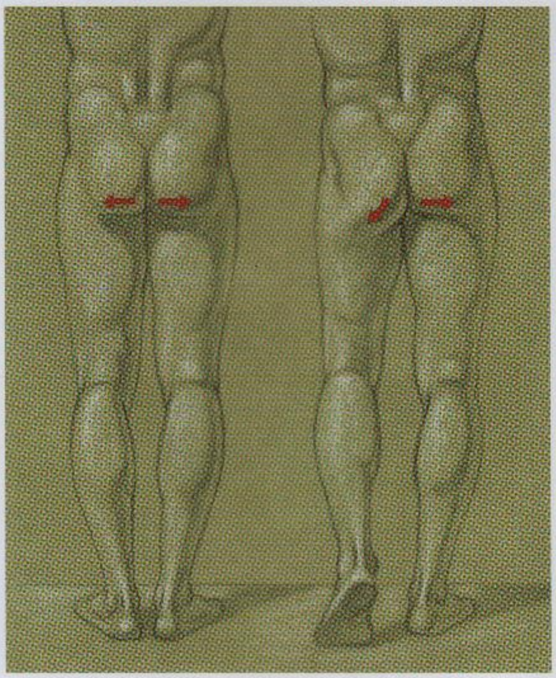
PRONOUNCIATION
GLOO-tee-ul

ORIGIN OF THE TERM
Greek *gloutos* = buttock

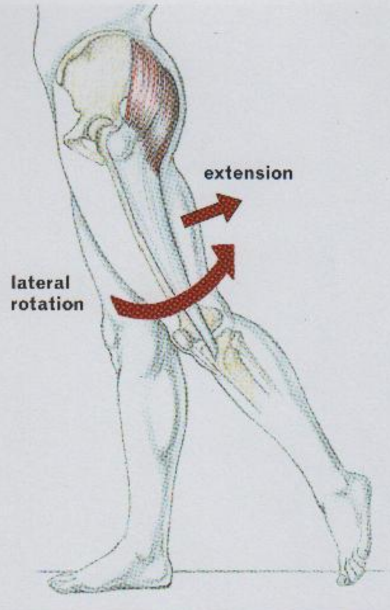
SYNONYMS
regio glutealis (TA), gluteus group, gluteal region, buttocks, "glutes"

GLUTEUS MEDIUS OR EXTERNAL OBLIQUE?

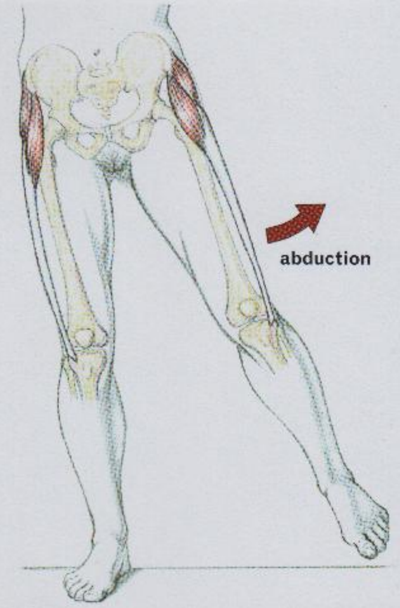
Sometimes the gluteus medius is confused with the flank pads of the external oblique muscle, which is positioned just above the gluteus medius on the iliac crest. To avoid confusion, observe the location of the iliac crest: Any bulge appearing above it is caused by the flank pads of the external oblique. A bulge immediately below the iliac crest, however, is a gluteal form. When the figure has excessive fatty padding, this particular region may register as one continuous shape because the fatty padding is covering the glutes and the flank pads, obscuring the evidence of the iliac crest and softening the overall form.



GLUTEAL FOLD OF GLUTEUS MAXIMUS
Posterior view of pelvis and legs



Gluteus maximus: extension of thigh at hip joint, lateral rotation of thigh (lateral view)



Tensor fascia latae and gluteus medius: abduction of thigh at hip joint (anterior view)

GLUTEAL GROUP—ACTION OF MUSCLES

muscle. This fold travels horizontally across the oblique muscle fibers of the gluteus maximus; when the knee bends, this horizontal fold relaxes and becomes an oblique curve that sweeps gently downward and then disappears.

ACTION OF THE MUSCLES

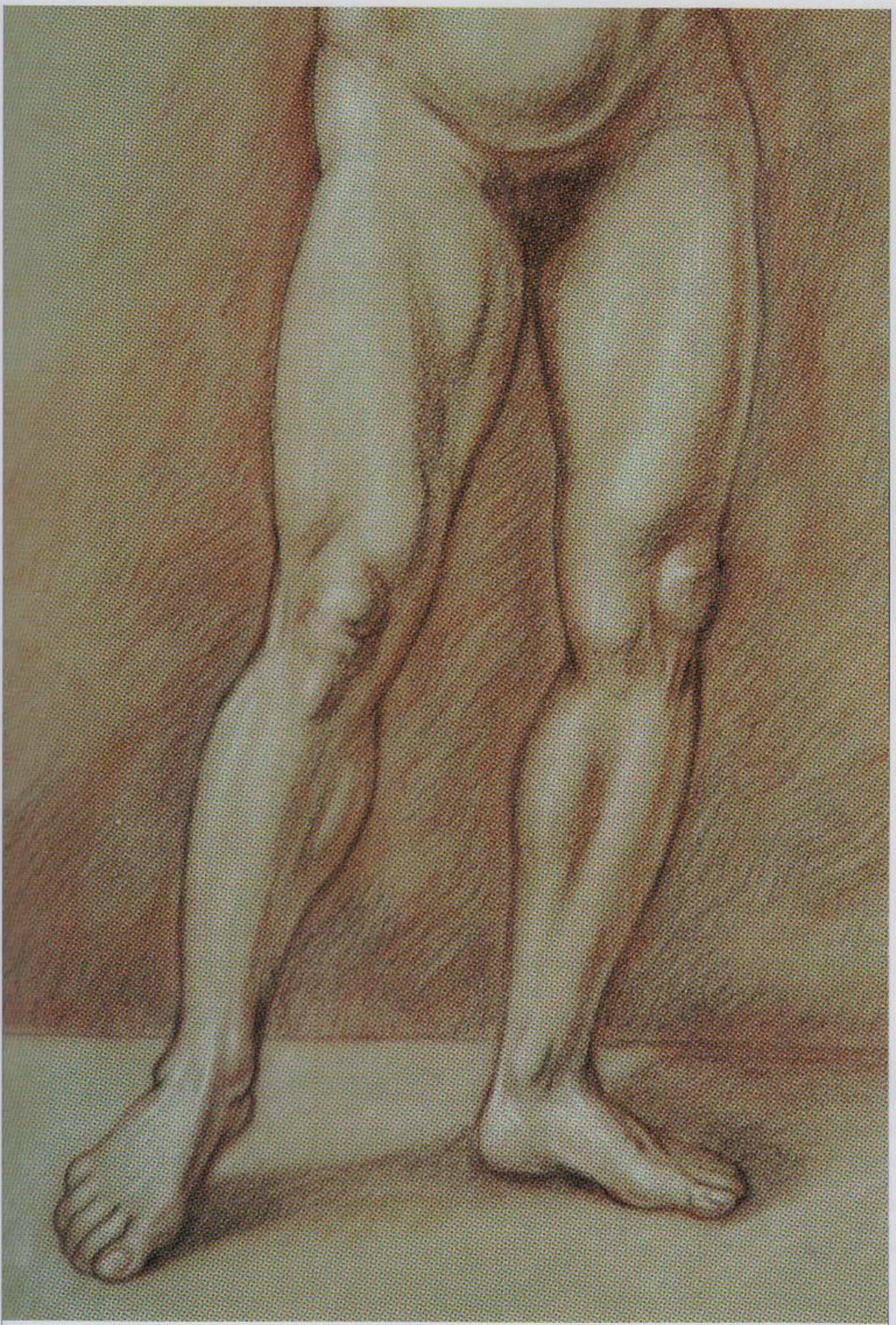
The gluteus maximus is the most powerful muscle of the gluteal group. It moves the thigh backward (extension of the thigh) and also assists in rotating the upper leg outward (lateral rotation of the thigh). The muscle is activated in climbing stairs, walking uphill, and rising from a seated position to a position of standing, as well as in running. The gluteus maximus acts as a lateral stabilizer of the hip and knee joints, and the gluteus maximus and the iliotibial tract also help maintain an upright posture.

The gluteus medius helps move the upper leg sideways, away from the body (abduction of the thigh) and assists in the medial rotation of the upper leg. This muscle is activated in walking, running, and stepping sideways and when shifting the weight onto one limb.

The tensor fascia latae assists in abducting the upper leg and in rotating it slightly inward. This muscle helps make the iliotibial tract taut, strengthening and stabilizing the knee joint.

Muscles of the Gluteal Group

MUSCLE	DESCRIPTION AND CHARACTERISTICS	ORIGIN OF THE TERM	SYNONYMS
Tensor Fascia Latae (TEN-sor FASH-ee-uh LAH-tee *or* TEN-sor FASH-ee-uh LAY-tee *or* TEN-sor FASH- ee-uh LAT-tee *or* TEN-sor FASH-ee-uh LAA-tuh)	A fleshy fusiform muscle, the tensor fascia latae begins near the ASIS on the iliac crest and travels obliquely down toward the greater trochanter, bypassing it to insert into the iliotibial tract. When the muscle is tensed, it produces a fleshy, teardrop-shaped prominence on the surface form.	Latin *tensor*, from *tendere* = to stretch + *fascia* = band or fillet + *latae* = broad, wide	musculus tensor fascia latae (TA), tensor of fascia latae, tensor fascia femoris, TFL
Gluteus Medius (GLOO-tee-us MEE-dee-us)	As the name implies, the gluteus medius is between the gluteus maximus and the tensor fascia latae and is the middle-sized muscle of the gluteal group. This fan-shaped muscle attaches on the outer portion of the ilium of the pelvis and then tapers to insert onto the greater trochanter of the femur. The gluteus medius is partially covered by the gluteus maximus in its back portion and by the tensor fascia latae in its front portion.	Greek *gloutos* = buttock + Latin *medius* = middle	musculus gluteus medius (TA)
Gluteus Maximus (GLOO-tee-us MACK-sih-muss)	As its name implies, the gluteus maximus is the largest muscle of the gluteal region. The muscle begins from the outer border of the sacrum and coccyx and the posterior part of the iliac crest. Its rich, sculptural forms pull slightly away from its bony origin in the sacroiliac region and then head toward the femur. The upper portion of the gluteus maximus inserts into the iliotibial tract; a lower, deeper portion inserts directly into the femur, although this is not apparent on the surface form. The iliotibial tract then inserts into the lateral condyle of the tibia.	Greek *gloutos* = buttock + Latin *maximus* = greatest	musculus gluteus maximus (TA), large buttock muscle



FRONT VIEW OF STANDING LEGS

The Muscles of the Lower Leg

Like those of the upper leg, the muscles of the lower leg (or, in the language of anatomy, the *leg*) are divided into compartments, each of which is associated with a specific group of muscles. The compartments, muscle groups, and individual muscles of the lower leg are as follows:

Anterior Compartment
Extensor group
- Tibialis anterior
- Extensor digitorum
- Extensor hallucis longus

Posterior Compartment
Flexor group
- Gastrocnemius
- Soleus

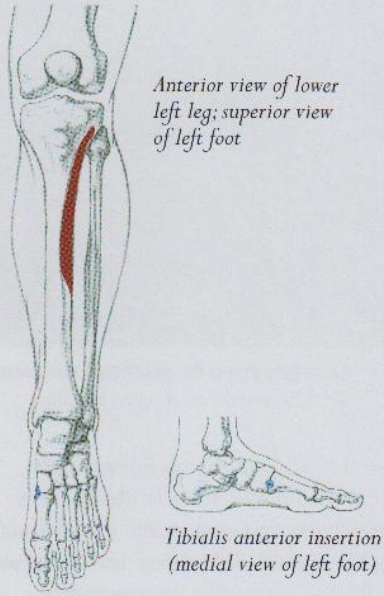
Lateral Compartment
Peroneal group
- Peroneus longus
- Peroneus brevis

Tibialis Anterior

PRONOUNCIATION
tib-ee-AL-iss an-TEER-ee-or

ORIGIN OF THE TERM
Latin *tibia* = shinbone + *anterior* = front

SYNONYMS
musculus tibialis anterior (TA), tibialis anticus, shin muscle, muscle of the shin, anterior tibial muscle



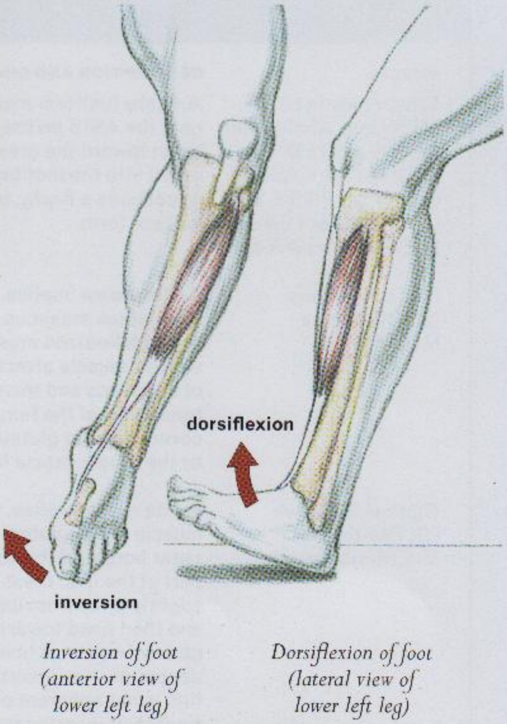
Anterior view of lower left leg; superior view of left foot

Tibialis anterior insertion (medial view of left foot)

TIBIALIS ANTERIOR—MUSCLE ATTACHMENTS

ORIGIN
- tibia (lateral surface of upper shaft, lateral condyle)
- interosseous membrane

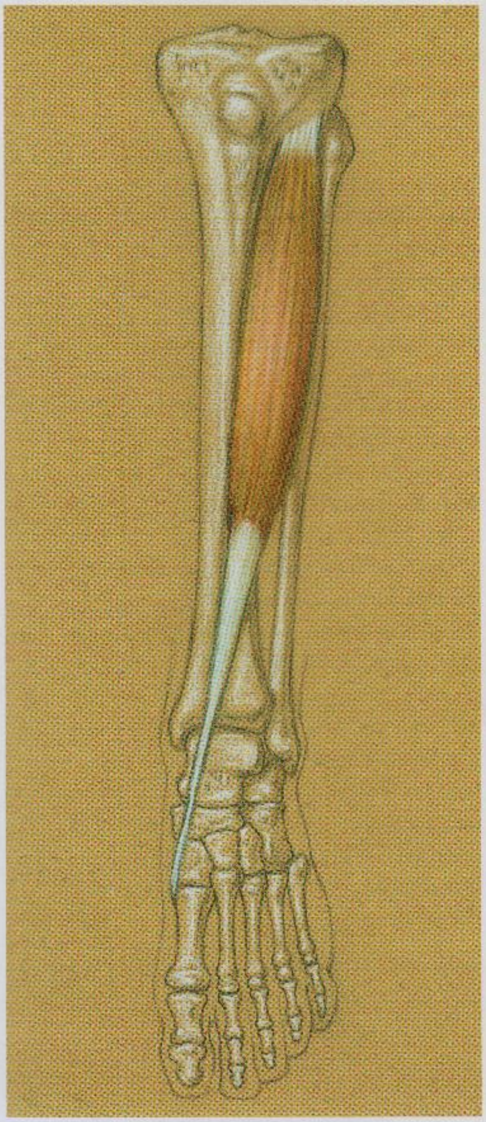
INSERTION
- foot (medial cuneiform and base of first metatarsal)



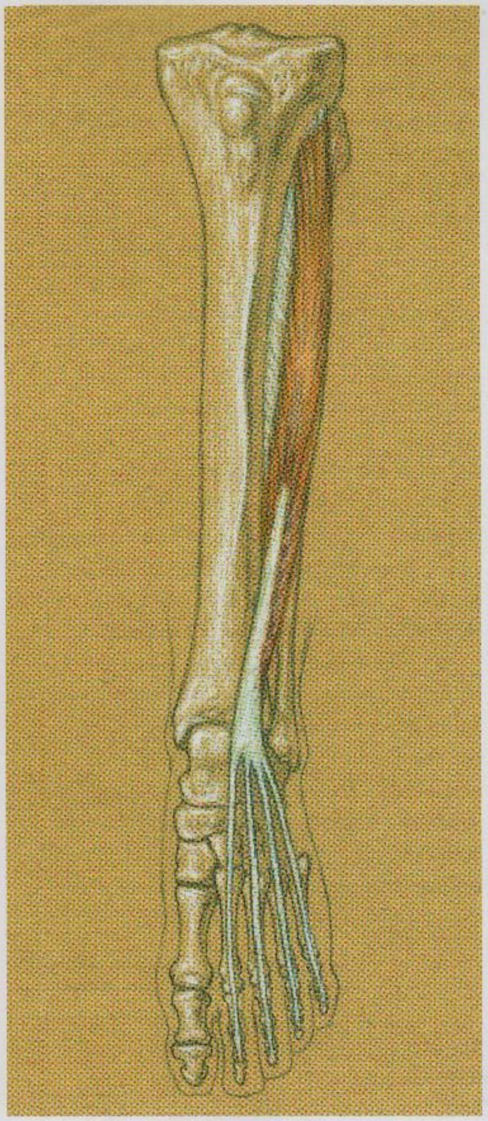
Inversion of foot (anterior view of lower left leg)

Dorsiflexion of foot (lateral view of lower left leg)

TIBIALIS ANTERIOR—ACTION OF MUSCLE



TIBIALIS ANTERIOR (ANTERIOR VIEW, LEFT LOWER LEG; SUPERIOR VIEW, LEFT FOOT)



EXTENSOR DIGITORUM LONGUS (ANTERIOR VIEW, LEFT LOWER LEG; SUPERIOR VIEW, LEFT FOOT)

Extensor Digitorum Longus

PRONOUNCIATION
ek-STEN-sor dij-ih-TOR-um LON-gus

ORIGIN OF THE TERM
Latin *extendere* = to stretch + *digit* = digit (toe) + *longus* = long

SYNONYMS
musculus extensor digitorum longus (TA), extensor longus digitorum pedis, extensor longus digitorum, long extensor of the toes

Anterior view of left lower leg; superior view of left foot

EXTENSOR DIGITORUM LONGUS—MUSCLE ATTACHMENTS

ORIGIN
- tibia (lateral condyle)
- fibula (head, anterior surface)
- interosseous membrane

INSERTION
- middle and distal phalanges of toes 2–5

Tibialis Anterior

Commonly called the shin muscle, the tibialis anterior is an elongated fusiform muscle that is positioned slightly obliquely on the front of the lower leg. It creates a subtle contour that is more noticeable in side views. The tibialis anterior begins on the lateral condyle and upper shaft of the tibia, as well as on the interosseous membrane that connects the tibia and fibula bones. It then descends downward at a slight angle along the sharp crest of the tibia known as the anterior border. About halfway down, the muscle fibers transform into a flat tendon. As it crosses toward the inner arch of the foot, the tendon becomes a thick, cordlike structure. It inserts into the medial surface of the medial cuneiform tarsal bone in the arch of the foot and into the base of the first metatarsal (of the great toe).

The tendon of the tibialis anterior is not noticeable on the surface form until the foot is raised upward in dorsiflexion; then, the tendon pops out near the ankle.

Note that the tendon of the tibialis anterior is *not* the tendon of the great toe, which belongs to the extensor hallucis longus. The tendon of the tibialis disappears on the medial part of the foot, while the tendon of the extensor hallucis longus heads directly toward the great toe, inserting into the upper surface of the distal phalanx.

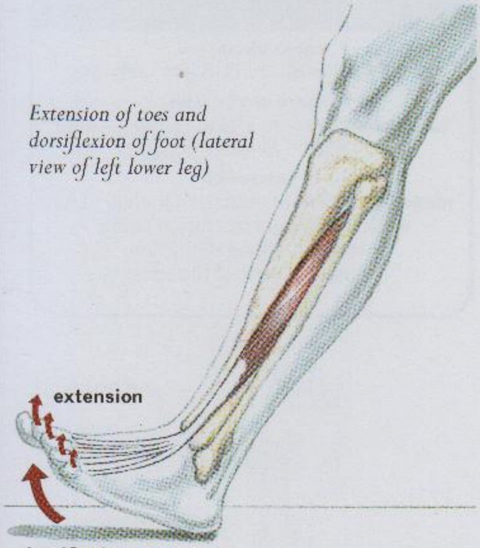
The muscular mass of the tibialis anterior is noticeable on the surface form when the toes are raised upward and when a person is standing on tiptoe, doing knee bends, or executing the ballet movement known as a grand plié.

ACTION OF THE MUSCLE

The tibialis anterior's main function is to help lift the front part of the foot upward in the movement called dorsiflexion. It is an important muscle in walking, helping to lift the foot off the ground as the leg swings forward (and thereby preventing the toes from catching on the ground). With the help of other muscles it also assists in the movement known as inversion of the foot, in which the bottom of the foot is turned toward the medial line of the body, as when someone looks at the bottom of his or her shoe.

Extensor Digitorum Longus

The extensor digitorum longus is located near the outer side of the lower leg, where it is partially hidden by the outer



Extension of toes and dorsiflexion of foot (lateral view of left lower leg)

EXTENSOR DIGITORUM LONGUS—ACTION OF MUSCLE

edge of the tibialis anterior. The muscle begins on the lateral condyle of the tibia, along more than half the length of the fibula, and on the interosseous membrane. Its flat tendon begins halfway down the lower leg, splitting into four separate tendons as it approaches the ankle joint. As the tendons fan out across the dorsum of the foot, each inserts into the middle and distal phalanges of one of the toes (toes 2–5). These tendons are prominent on the surface form when the toes are extended upward or spread apart.

ACTION OF THE MUSCLE

As its name implies, the extensor digitorum longus is the long extender of the toes. When the muscle contracts, it pulls the lateral four toes (toes 2–5) upward at the metatarso-phalangeal joints. The muscle also helps raise the front part of the foot upward from the ankle joint in the movement known as dorsiflexion of the foot. The muscle is activated in the movement of walking when the leg swings forward and the foot and toes move upward to clear the ground before the heel and bottom of foot strike the ground.

Extensor Hallucis Longus

The other muscles on the front side of the tibia mostly hide the extensor hallucis muscle; only the tendon shows as it emerges from between the tibialis anterior and the extensor digitorum longus. This tendon forms a rich, strong cord that travels downward to insert into the great toe.

When the great toe is raised upward, the tendon of the extensor hallucis longus can be clearly seen on the surface form. The tendon of the tibialis anterior rides close to the tendon of the great toe but then heads toward the instep of the foot, where it attaches on the medial surfaces of the first cuneiform and first metatarsal of the foot. The tendon of the extensor hallucis longus attaches on the base of the distal phalanx of the great toe on the dorsal side of the foot.

ACTION OF THE MUSCLE

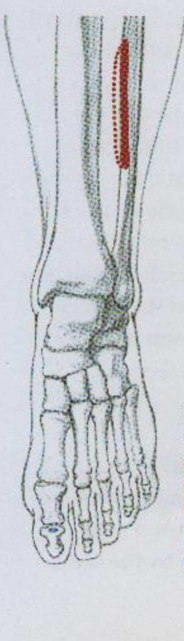
The main action of the extensor hallucis longus is to extend the large toe, pulling it upward when the muscle contracts. It also assists in the action of dorsiflexion, moving the foot upward at the ankle joint.

Extensor Hallucis Longus

PRONOUNCIATION
ek-STEN-sor HAL-loo-sis LON-gus
or
ek-STEN-sor HAL-luc-kiss LON-gus

ORIGIN OF THE TERM
Latin *extendere* = to stretch + *hallux* = great toe + *longus* = long

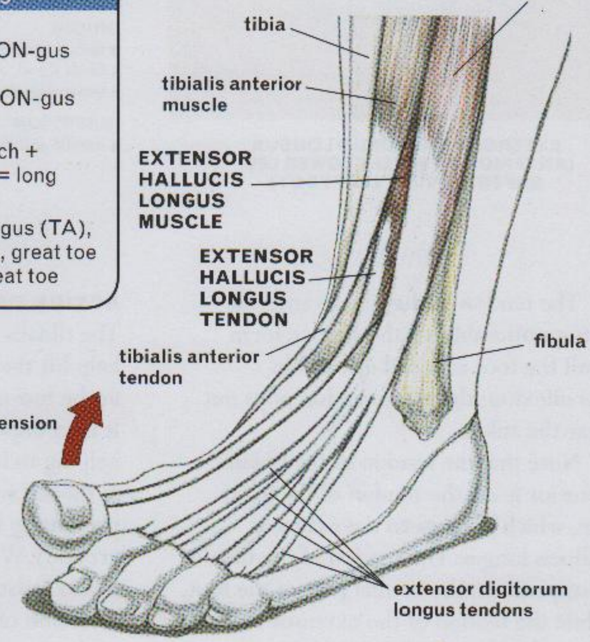
SYNONYMS
musculus extensor hallucis longus (TA), extensor proprius hallucis, EHL, great toe muscle, long extensor of great toe



EXTENSOR HALLUCIS LONGUS —MUSCLE ATTACHMENTS

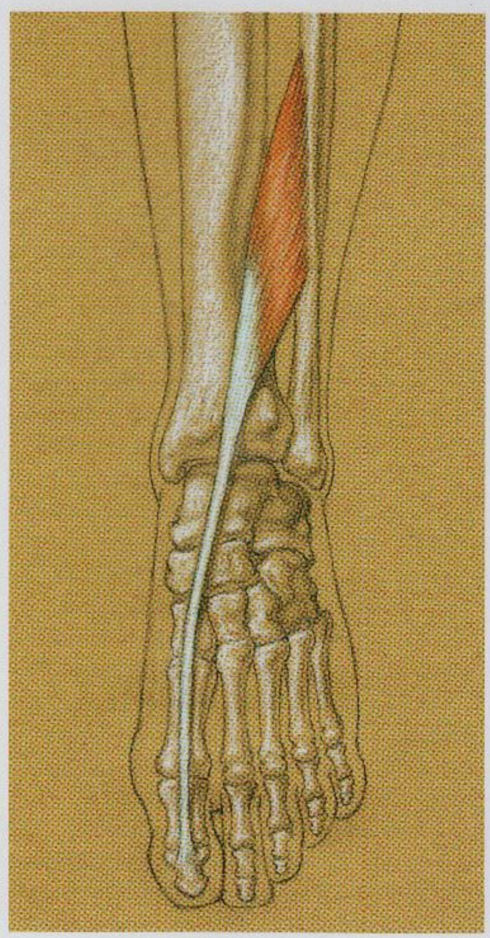
ORIGIN
- fibula (medial surface)
- interosseous membrane

INSERTION
- distal phalanx of great toe

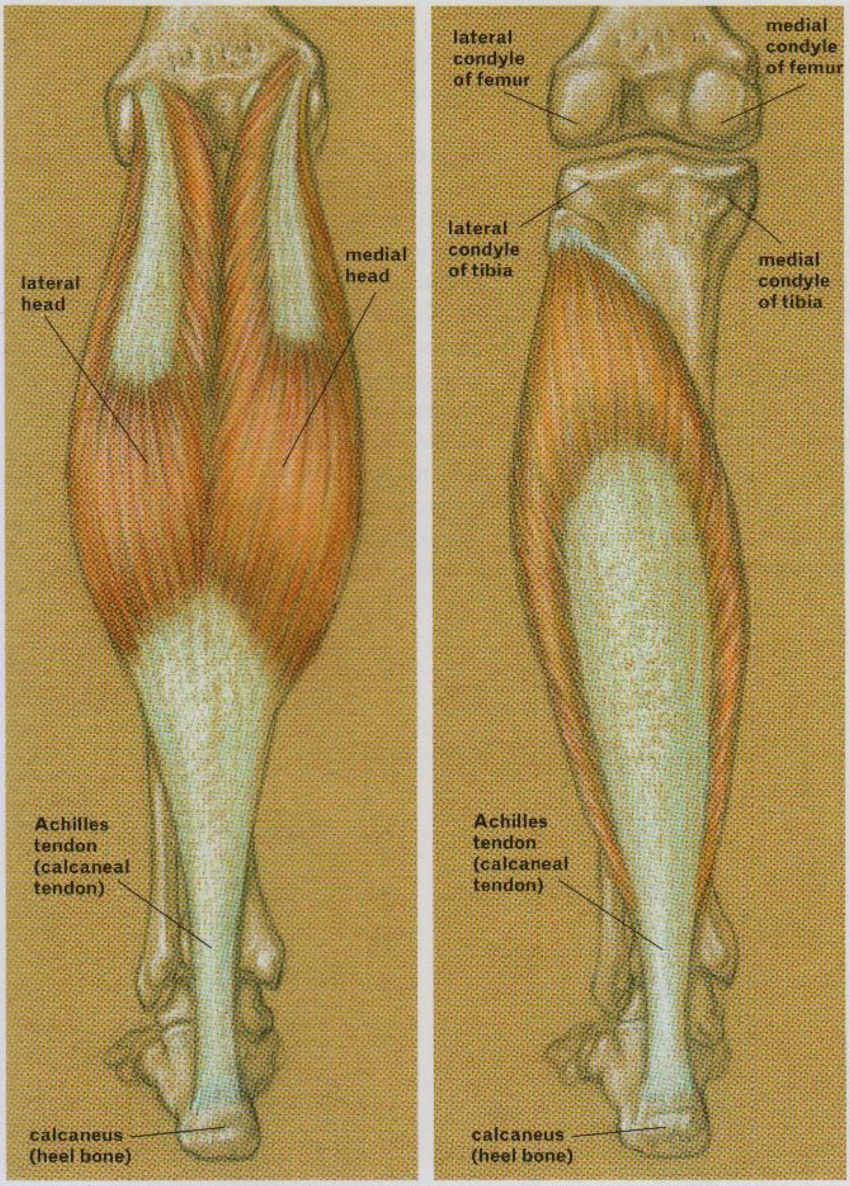


EXTENSOR HALLUCIS LONGUS—ACTION OF MUSCLE

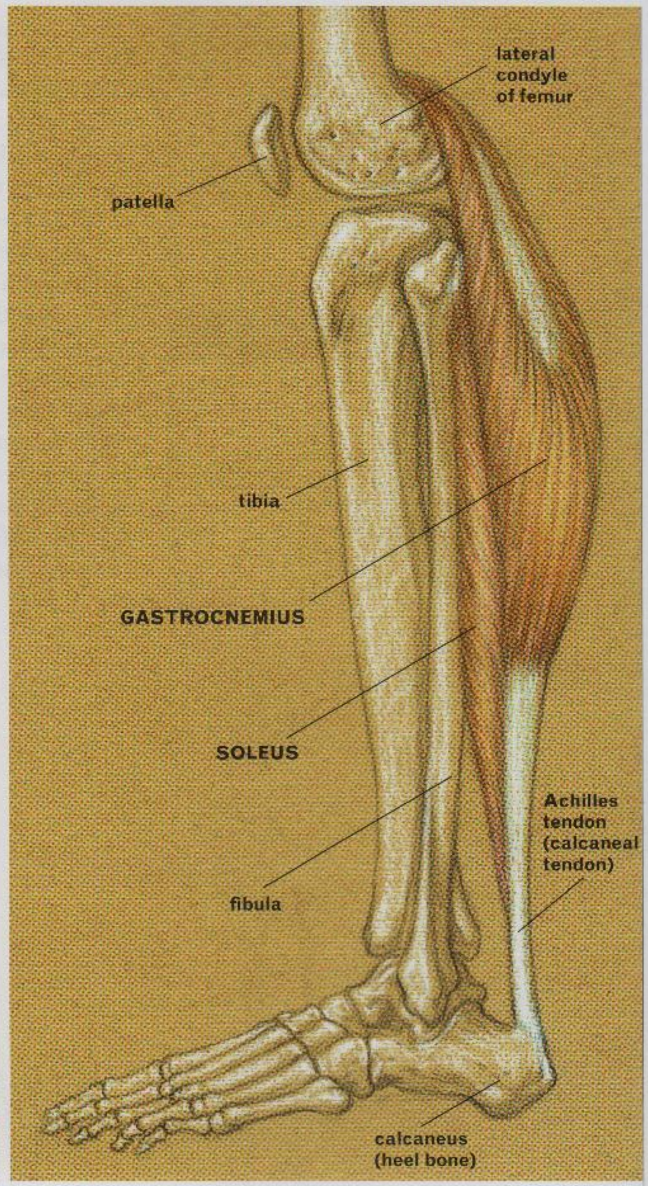
Extension of great toe (lateral three-quarters view of left foot)



EXTENSOR HALLUCIS LONGUS



GASTROCNEMIUS AND SOLEUS (POSTERIOR VIEW, LOWER LEFT LEG)
Left: Gastrocnemius. Right: Soleus.



GASTROCNEMIUS AND SOLEUS (LATERAL VIEW, LOWER LEFT LEG)

Gastrocnemius and Soleus

SYNONYMS
musculus triceps surae (TA), triceps surae, triceps of the calf

Gastrocnemius and Soleus

The major muscles of the back of the lower leg are the gastrocnemius and the soleus. Anatomists sometimes label these two muscles as the *triceps surae,* meaning the three-headed muscle of the calf, because the two-headed gastrocnemius muscles and the single-headed soleus share the same tendon.

Commonly called the *calf,* the gastrocnemius is a powerful, bulging, oval-shaped muscle with two portions (usually referred to as heads) that attach into the massive condyles on the posterior part of the femur. The *outer head* (or *lateral head*) attaches above the lateral condyle of the femur, and the *inner head* (or *medial head*) attaches above the medial condyle of the femur. The bulk of this muscle is located on the upper half of the posterior portion of the lower leg; about midway down the lower leg, the fibers merge into a wide, flat tendon, which then tapers into a strong cord to insert into the *calcaneus* (or *heel bone*). This tendon is referred to anatomically as the *calcaneal tendon* but is more commonly known as the *Achilles tendon.* It is an important surface landmark because its cordlike structure contrasts in an interesting way with the bulbous quality of the calf and the rich, little round shape of the heel.

Usually, the two heads of the gastrocnemius register as a single large

Gastrocnemius

PRONOUNCIATION
gas-trock-NEE-mee-us

ORIGIN OF THE TERM
Greek *gaster* = belly + *knēmē* = leg, shank, shinbone

SYNONYMS
musculus gastrocnemius (TA), calf muscle, calf

Soleus

PRONOUNCIATION
SO-lee-us *or* SOL-ee-us

ORIGIN OF THE TERM
Latin *solea* = a flat fish (the sole) or a leather sole strapped on the foot (a sandal)

SYNONYM
musculus soleus (TA)

form, but when the muscle is under tension a slight furrow appears between the two heads. The inner head usually sits slightly lower than the outer head, creating a distinct shift in angles in the contour of the lower leg when seen from both back and front views.

The soleus muscle is positioned underneath the gastrocnemius. Its shape resembles that of the fish called the sole or the bottom of a Roman-style sandal. The muscle begins on the head and shaft of the fibula and on part of the tibia. Its muscular fibers attach into the calcaneal tendon (Achilles tendon), which it shares with the gastrocnemius. On the surface, the soleus can be seen only as slender ridges on either side of the calcaneal tendon because the rest of the muscle is concealed by the gastrocnemius.

ACTION OF THE MUSCLES

The gastrocnemius assists in the flexion of the lower leg (tibia) at the knee joint. Together, the gastrocnemius and soleus are the prime movers for the plantar flexion of the foot, in which the foot points downward. They also help propel the body in various active movements, such as walking, jumping, and running. These muscles also help raise the heel from the ground in the action of standing on tiptoe, and they are also active when dancing on the toes (en pointe), as in ballet.

Gastrocnemius (posterior view of lower left leg)

Soleus (posterior view of lower left leg)

GASTROCNEMIUS AND SOLEUS—MUSCLE ATTACHMENTS

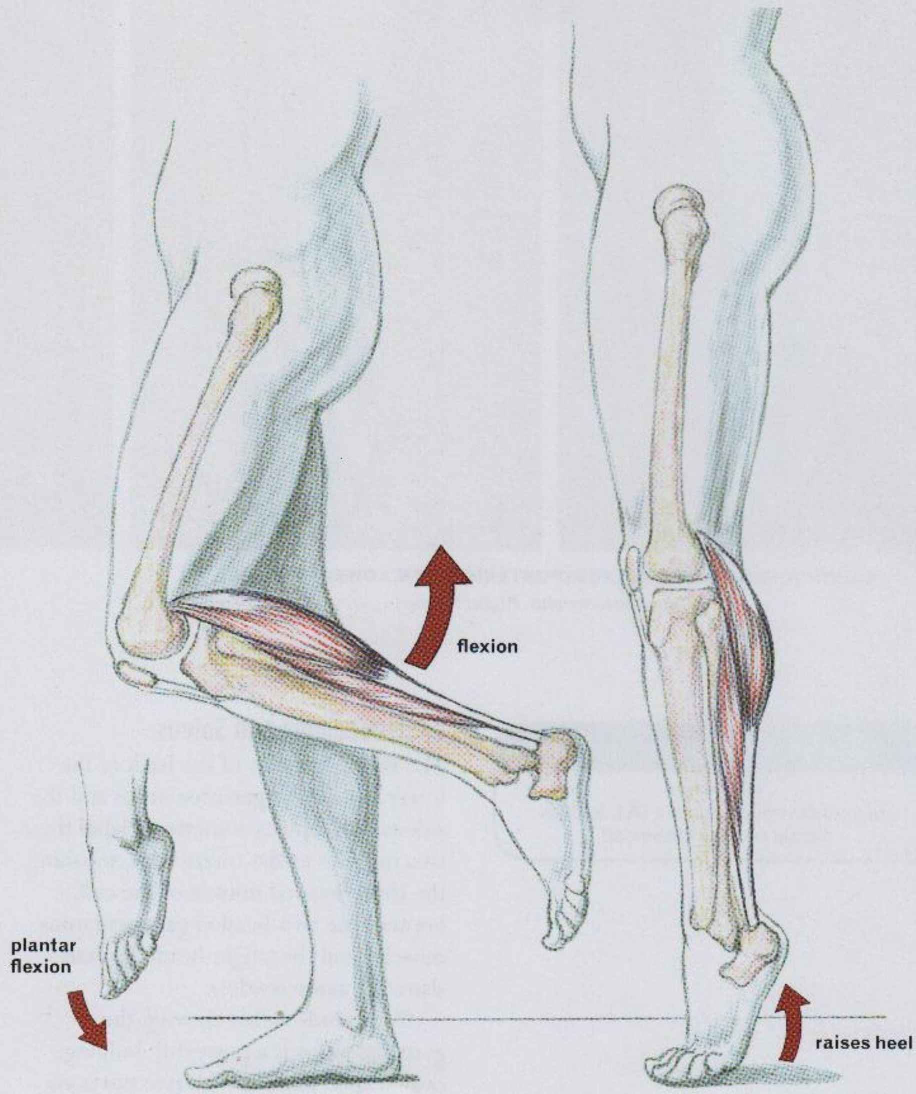
ORIGIN (GASTROCNEMIUS, LATERAL HEAD)
- femur (lateral condyle)

ORIGIN (GASTROCNEMIUS, MEDIAL HEAD)
- femur (medial condyle)

INSERTION (GASTROCNEMIUS)
- posterior surface of calcaneus (heel bone)

ORIGIN (SOLEUS)
- fibula (head, posterior surface)
- tibia (medial border)

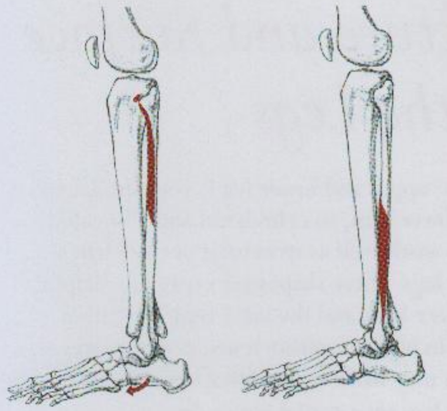
INSERTION (SOLEUS)
- posterior surface of calcaneus (heel bone)



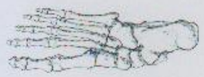
Flexion of lower leg at knee joint; plantar flexion of foot (lateral view of upper and lower left leg)

Raising of heel in tiptoe pose (lateral view of upper and lower left leg)

GASTROCNEMIUS AND SOLEUS—ACTION OF MUSCLES



Left: Peroneus longus—origin (lateral view of left lower leg and foot). Right: Peroneus brevis—origin and insertion (lateral view of left lower leg and foot).



Peroneus longus—insertion (view of plantar surface [sole] of left foot)

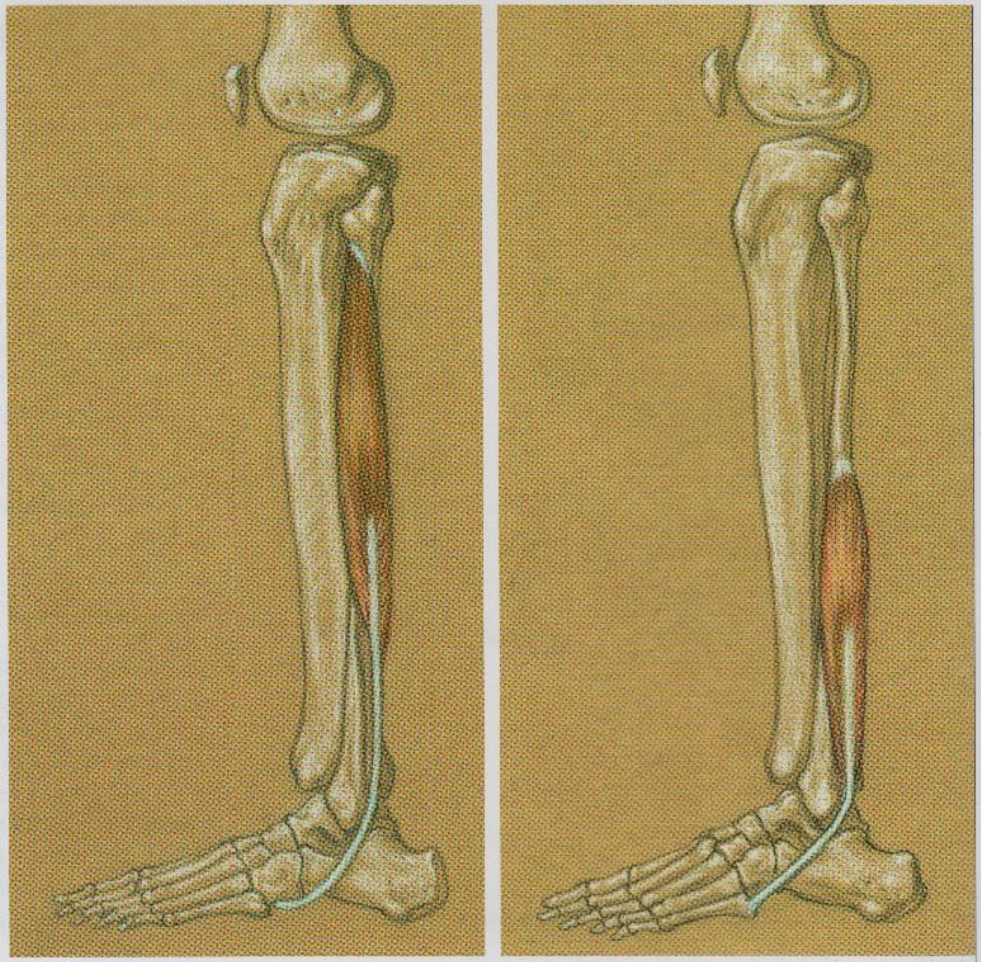
PERONEUS LONGUS AND PERONEUS BREVIS—MUSCLE ATTACHMENTS

ORIGIN (PERONEUS LONGUS)
- fibula (head and upper lateral surface)

INSERTION (PERONEUS LONGUS)
- foot (base of first metatarsal and plantar surface of medial cuneiform)

ORIGIN (PERONEUS BREVIS)
- fibula (lower two-thirds, lateral side)

INSERTION (PERONEUS BREVIS)
- foot (fifth metatarsal, base)



PERONEUS LONGUS AND PERONEUS BREVIS (LATERAL VIEW, LEFT LOWER LEG)
Left: Peroneus longus. Right: Peroneus brevis.

Eversion of foot (anterior three-quarters view of lower left leg)

Plantar flexion of foot (anterior lateral view of lower left leg)

PERONEUS LONGUS AND PERONEUS BREVIS—ACTION OF MUSCLES

Peroneus Longus and Peroneus Brevis

The peroneus longus and peroneus brevis are located on the lateral side of the lower leg. Both are elongated muscles positioned on the fibula. The muscular fibers of the peroneus longus are located higher up than the fibers of the peroneus brevis, which is positioned lower on the fibula. Together, the muscles form a ridge-like form (looking like a bootstrap) on the outer part of the leg.

The muscles' tendons descend vertically, passing around the knobby shape of the outer anklebone (lateral malleolus) in a fashion somewhat like the cords of a pulley. The tendons appear as a sharp ridge above the anklebone and are sometimes mistaken for the fibula. At this point, below the ankle bone, the two tendons travel in separate directions, attaching into different areas of the foot.

ACTION OF THE MUSCLES

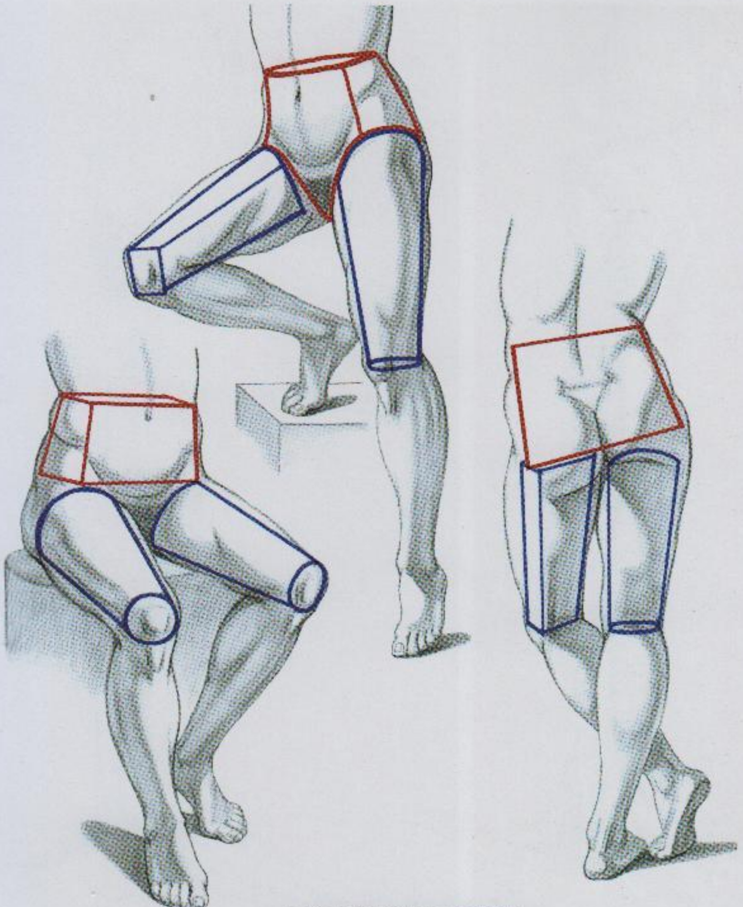
The peroneus longus and the peroneus brevis together help move the foot in a downward movement from the ankle joint (plantar flexion). They also assist in turning the sole of the foot outward in the action of eversion. The muscles also act as a bootstrap, helping to stabilize the outer ankle and assisting in supporting the arches of the foot. The muscles are activated when running and when walking on uneven surfaces.

Peroneus Longus and Peroneus Brevis

PRONOUNCIATION
pair-oh-NEE-us LON-gus *or* pair-ROWN-ee-us LON-gus
and
pair-oh-NEE-us BREV-iss *or* pair-ROWN-ee-us BREH-viss

ORIGIN OF THE TERM
Greek *perone* = the fibula (brooch or buckle) + Latin *longus* = long and *brevis* = short

SYNONYMS
Peroneus longus: musculus peroneus longus (TA), musculus fibularis longus (TA), fibularis longus, long fibular muscle, long peroneal muscle;
Peroneus brevis: musculus peroneus brevis (TA), musculus fibularis brevis (TA), fibularis brevis, short peroneal muscle



LEG AND PELVIS FORMS

The Structure and Surface Forms of the Legs

The overall shape of the upper and lower leg is very similar to that of the upper and lower arm, so cylindrical and elongated rectangular shapes also work well as structural devices when lightly sketching in the legs. These shapes are especially helpful when one or both legs are bent and the knee region is either receding or advancing. In highly foreshortened poses, however, a more organic structure may work better for your underdrawing.

When depicting the legs on a seated figure, be careful not to place them too low on the shape of the pelvis. The cylindrical mass of the upper leg fits high up into the pelvic block; if you place the legs too low, you will inadvertently elongate the pelvis.

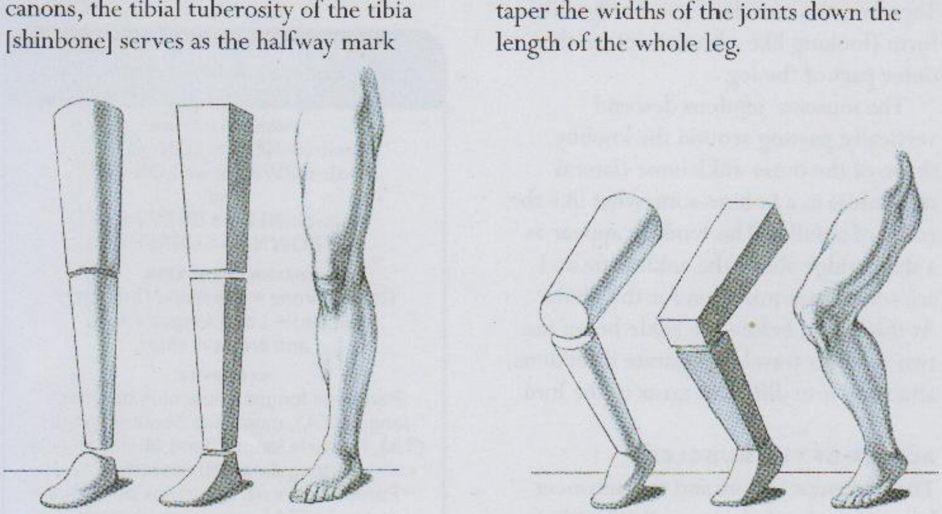
Proportions of the Leg

Different drawing texts present the proportional breakdown of the leg somewhat differently, but the version presented here is more or less standard and very easy to remember:

First, find the anatomical center—the location of the pubic bone and greater trochanter of the femur—on the standing figure. Then locate the bottom of the patella (kneecap). This length will be approximately the same as the length of the lower leg from the bottom of the patella to the bottom of the foot positioned on the ground. As you look for the bottom of the patella, keep in mind that there are sometimes two similar shapes at the kneecap area: The upper, rounder shape is the bony form of the kneecap itself, while the shape immediately below it is composed of fatty tissue. The line of measurement should be directly below the patella, not the fatty-tissue form.

(Note that in some proportional canons, the tibial tuberosity of the tibia [shinbone] serves as the halfway mark between the anatomical center and the bottom of the foot placed on the ground.)

Also observe the differences in the width of the leg at the key joints. The hip joint, where the leg attaches into the pelvis, is the widest. The knee joint is not as wide as the hip, and the ankle joint is even narrower than the knee. Your drawings of legs will look more natural—not too stocky or chunky—if you slightly taper the widths of the joints down the length of the whole leg.



Cylinder forms *Block forms*

Cylinder forms *Block forms*

DEPICTING THE LEG—CYLINDER AND BLOCK FORMS

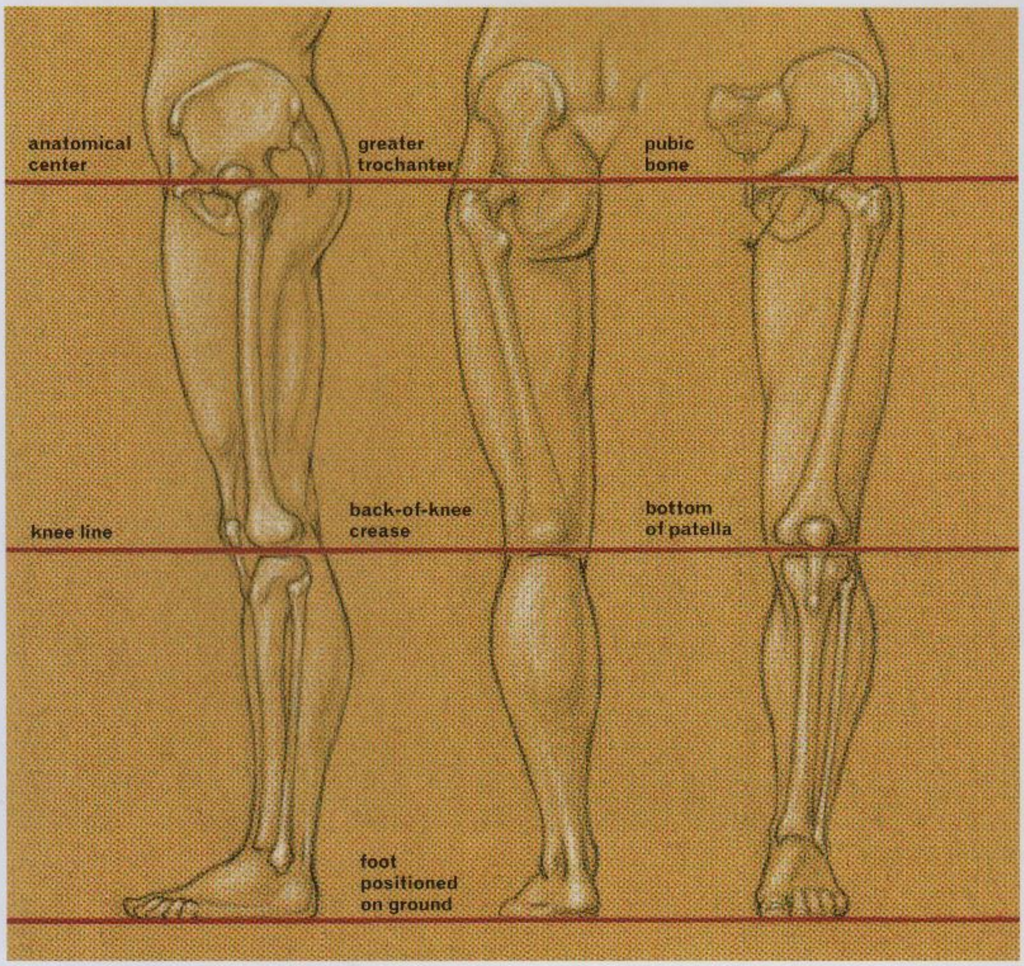
Angles and Rhythm of the Leg

To make your depictions of legs appear less static and more natural, you should also become aware of the leg's angles and rhythms.

Beginning at the bottom of the leg, notice the angle that occurs if you draw an imaginary line through the anklebones. The anklebones are actually two different bones, and when the foot is placed flat on the ground, the outer ankle falls lower than the inner anklebone in either a front or a back view.

Now, travel up the shin (in a front view) or the calf (in a back view), and notice that the angle of the calf muscle, or gastrocnemius, is opposite that of the angle of the anklebones: The outer head of the gastrocnemius is slightly higher up on the leg than the inner head.

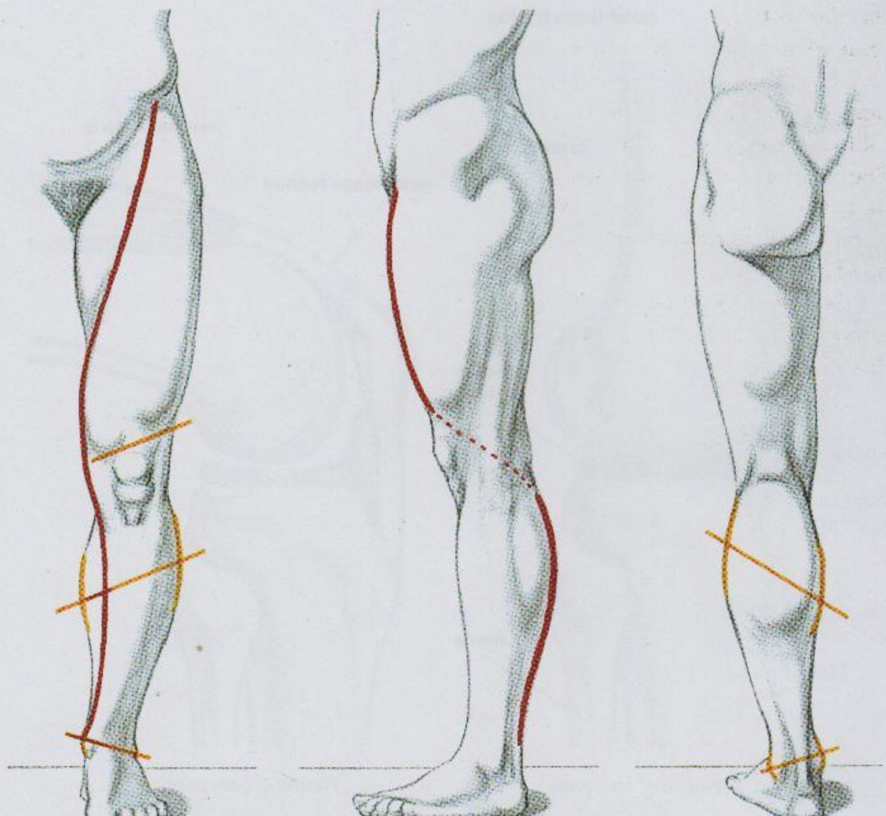
Now go to the thigh. If the quadriceps muscles are contracted, another angle will appear, this one just above the knee region. Here, the outer head of the quadriceps is higher up than the lower head, producing a tilt that is very similar to the angle of the calf muscle.



PROPORTIONS OF THE LEG
Left: Lateral view of left leg
Center: Posterior view of left leg
Right: Anterior view of left leg

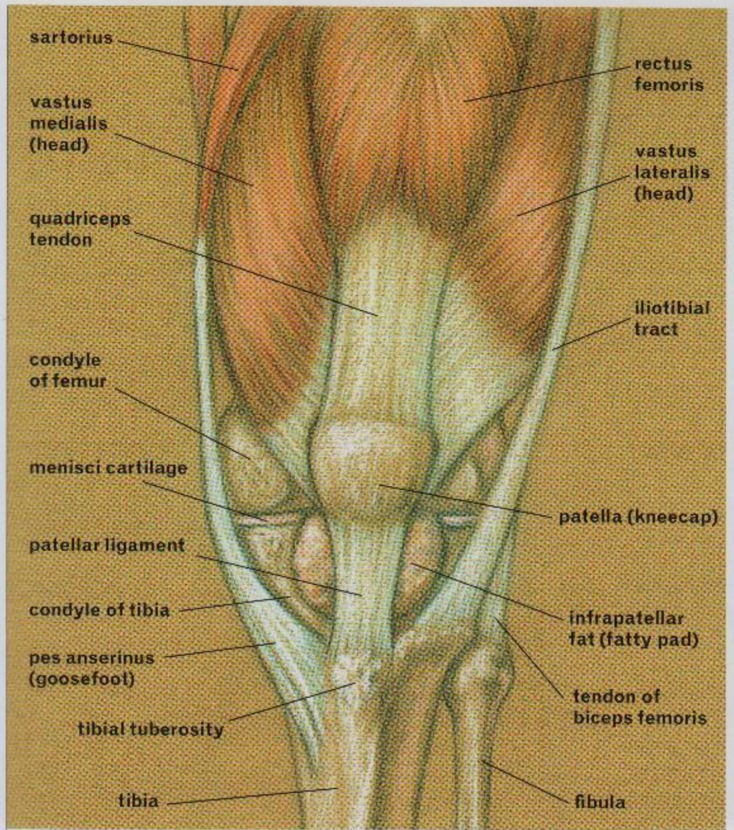
You should also learn to look for rhythmic alignments occurring within the forms of the leg in a given pose. Notice that, in a front view of a standing figure, a sweeping, stretched-out S shape descends from the ASIS of the pelvis (where the sartorius muscle attaches), follows the sartorius down to its attachment on the inner part of the tibia (shinbone), and then continues down along the tibia and out from the inner ankle. This curve can be subtle, but it gives a gentle rhythmic quality to the whole leg. (This serpentine line may be more strongly emphasized in a quick gesture drawing.)

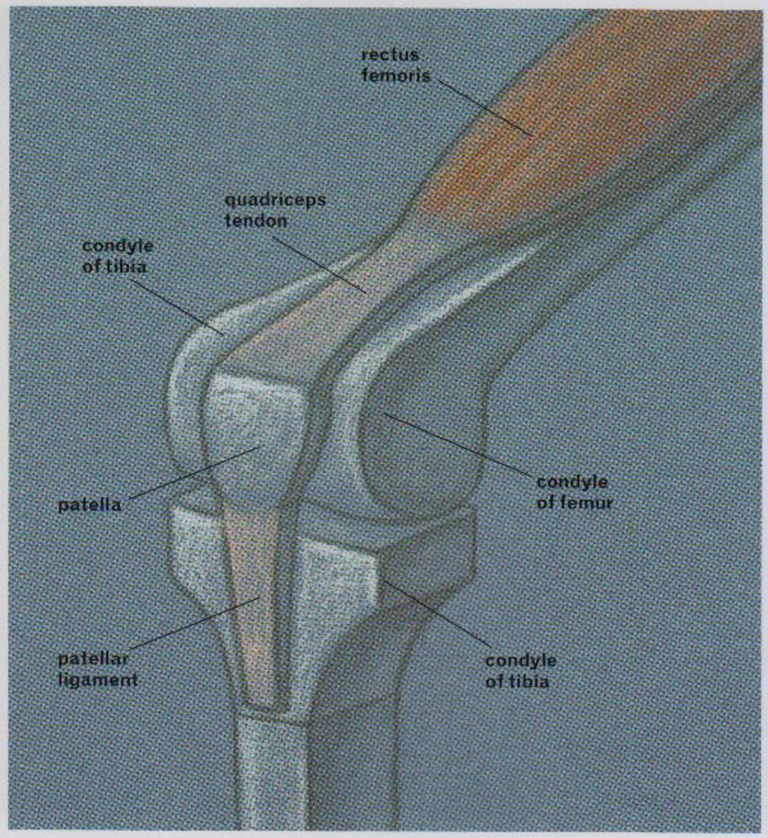
Another S curve appears in a side view of the upper and lower leg. Here, the rhythmic curve again begins on the ASIS but then moves along the outer bulge of the quadriceps group (the upper thigh muscles) and crosses over at the knee joint to the fuller form of the calf muscle. The subtler curves of hamstring group, at the back of the thigh, and of the shin muscle (tibialis anterior), on the front of the tibia, should be indicated with a more subdued contour so as to not compete with the richer forms of the quads and calf muscle.



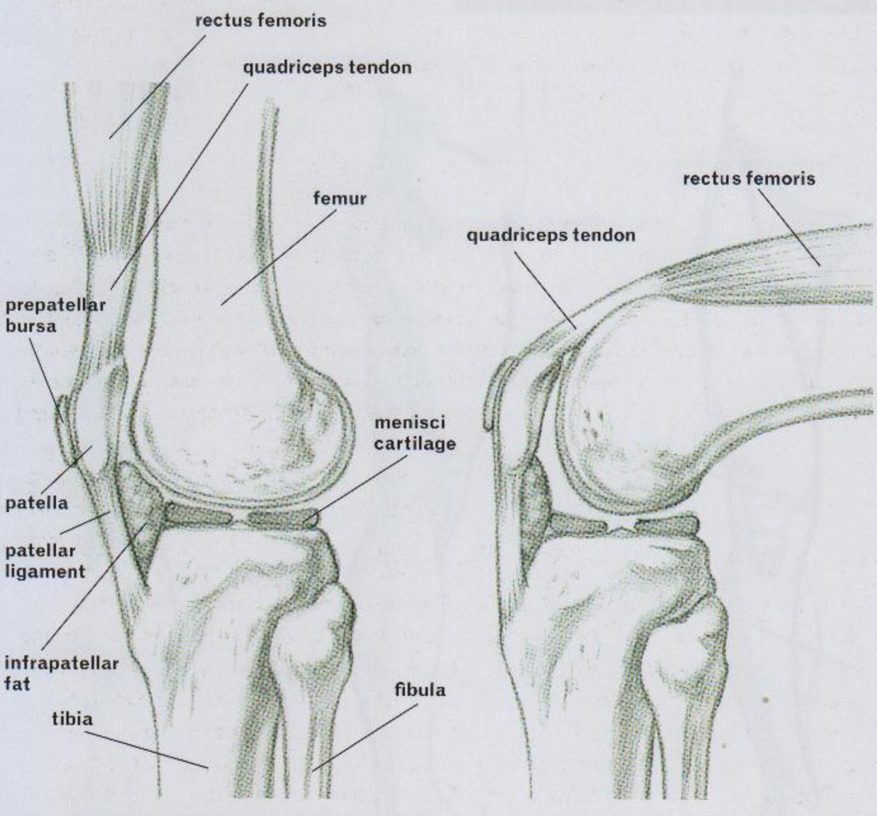
Anterior view of left leg *Lateral view of left leg* *Posterior view of left leg*

ANGLES AND RHYTHM OF THE LEG





Left: **KNEE REGION (ANTERIOR VIEW, KNEE REGION OF LEFT LEG)**
Right: **SIMPLIFIED PLANES OF KNEE REGION**



Extension of knee joint *Flexion of knee joint*

KNEE JOINT WITH PATELLA (LATERAL VIEWS, KNEE REGION OF LEFT LEG)

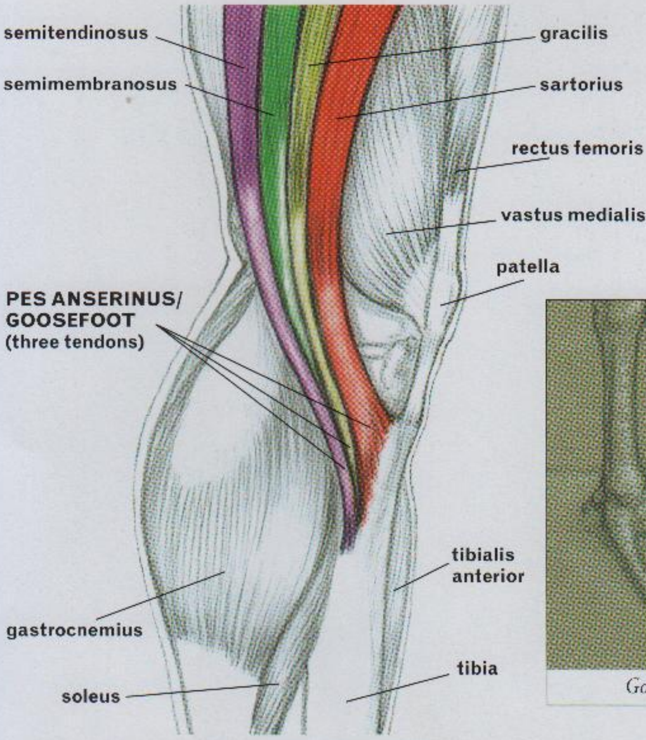
The Knee Region

The knee region consists of bony structures (including the condyles of the femur and of the tibia), the kneecap bone (patella), and other anatomical forms, such as tendons, ligaments, and fatty pads.

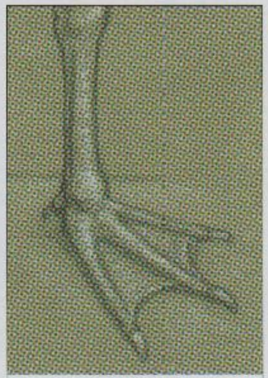
The common tendon of the quadriceps muscles of the thigh inserts on the top portion of the patella and continues downward to insert into the tibial tuberosity of the tibia. The patella enables the tendon of the quadriceps to glide smoothly during movement and also serves as a shield protecting the vulnerable joint of the knee.

Some anatomists consider the fibrous, straplike band that connects from the patella to the tibial tuberosity a continuation of the quadriceps tendon; these experts refer to this band as the *patellar tendon*. Other experts, however, call this same fibrous strap the *patellar ligament*.

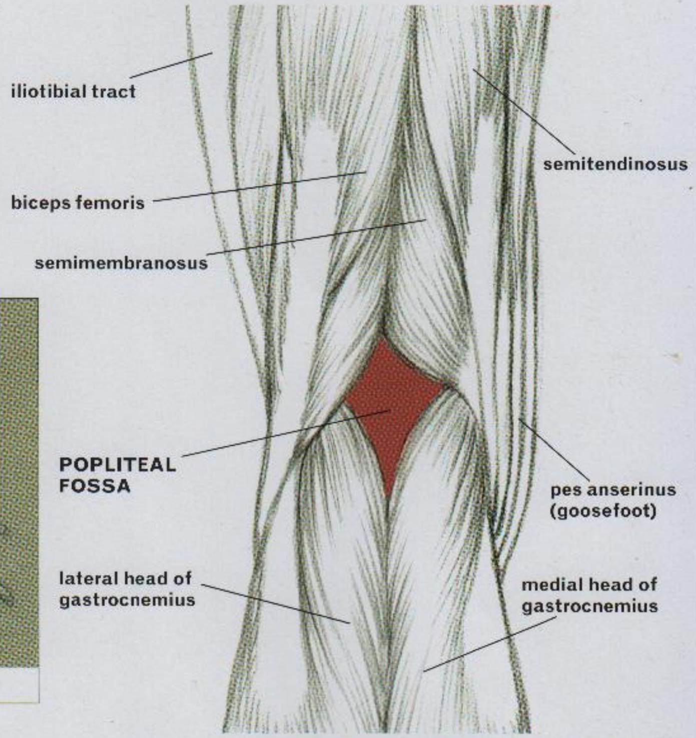
So is it a tendon or a ligament? In this book's first chapter, tendons were defined as structures that connect muscle to bone, while ligaments were described as structures that connect bone to bone. Actually, either term makes sense when describing the fibrous band of the patella. According to one view, when the tendon of the quadriceps inserts downward



PES ANSERINUS, OR GOOSEFOOT
(MEDIAL VIEW, LEFT LEG)



Goose's foot



POPLITEAL FOSSA (POSTERIOR VIEW,
KNEE REGION OF LEFT LEG)

into the tibial tuberosity of the tibia, the patella (a large sesamoid bone) is merely *embedded within* the tendon. This interpretation therefore sees the entirety of the fibrous tissue a tendon.

The alternative view is actually the more traditional. According to this view, the tendon of the quadriceps attaches into the bone of the patella (muscle to bone); from the patella, the fibrous band attaches to the tibial tuberosity. This portion of the fibrous band therefore functions as a ligament, because it attaches from bone to bone. Figurative artists, obviously, have little stake in this argument; for our purposes, the patellar tendon/patellar ligament is important because of its role in visually defining the knee region, especially when the knee is flexed (bent), when it is more apparent on the surface form.

Behind the patellar ligament is a fatty pad, called the infrapatellar fat, which acts as a shock absorber for the knee joint. When the leg is extended (straightened), this padding can be seen bulging out on each side of the patellar ligament, producing a round, soft mound directly below the patella. When the knee is flexed (bent), the fatty pad becomes stretched and is no longer visible on the surface form. Instead, the patellar ligament becomes more apparent.

Around the fatty pad are a number of little sacs of fluid, called *bursae,* which help decrease friction on the knee joint. Most of these are not visible on the surface form, but one very small, disc-like bursa, located on the front surface of the patella directly behind the skin, slightly fleshes out the kneecap's shape.

Various bands of ligaments and cartilage connect the tibia and femur, thereby helping to stabilize the knee joint, especially during movement. A special type of cartilage, called the *menisci* (sing., *meniscus*) and located on the top surface of the tibia, functions as a cushion against shocks and helps distribute the weight of the body.

Pes Anserinus, or Goosefoot

On the medial region of the knee joint is a rich, bulbous form that is especially noticeable when the upper and lower leg are extended (straight). The tendons of three muscles—the sartorius, gracilis, and semitendinosus—create the form as they wrap around the medial condyles of the femur and tibia. The insertions of the three tendons, as a group, are called the pes anserinus, (pron., pes an-ser-EYE-nus), which means "goosefoot" in Latin, because their tendinous attachments on the tibia resemble the webbed foot of a goose. A bursa lying between and under these tendons helps flesh out the forms to give this area of the leg its bulging characteristic.

Popliteal Fossa

A diamond-shaped space called the popliteal fossa—pronounced pop-LIT-ee-al FOSS-ah or pa-pal-TEE-al FOSS-ah, and deriving from the Latin term *poples,* meaning "ham"—is located on the back of the knee joint region, positioned above the origins of the gastrocnemius heads and flanked by the tendons of the hamstring muscles near their insertions. This area of transition between the upper leg and lower leg consists mainly of lymph nodes, nerves, and blood vessels, all embedded within fatty tissue called the *popliteal fat pad,* which forms a soft swelling on the surface form when the leg is extended (straight).

When the knee is bent, however, the tendons of the hamstrings pop out on either side of the popliteal fossa, and a hollow forms within this space. When the knee is straightened, the hollow disappears and is again replaced by the soft bulge of the popliteal fat pad. The crease at the back of the knee is in this same area.

Chapter 7 The Foot

Various cultures have viewed the foot very differently through the centuries. In some cultures, the foot is treated respectfully and considered a symbol of humility. In others, the foot is regarded as one of the most impure parts of the body and is often despised.

Human civilizations have fashioned an immense variety of footwear in which to encase the foot: everything from sandals, slippers, and boots, to balance-challenging stiletto heels, to roller blades. Often, the feet have been painfully altered to conform to fashion. In China, for many hundreds of years up into the twentieth century, the feet of upper-class girls were bound and stuffed into tiny "lotus" slippers—causing a severe and disabling deformity that was considered attractive (and necessary to catching a husband). In other cultures, the foot has been adorned in jewelry (toe rings, anklets, small bells) and painted or tattooed with elaborate designs.

Yet for all the different attitudes people have toward the foot, it must be acknowledged as one of the important structures of the human figure. Artists should learn the secrets of depicting the foot and should become aware of its fascinating structure.

Artists have sometimes paid meager attention to the foot, believing it to be a relatively unimportant form (especially when compared to the dynamic form of the hand). Usually, it has been the more traditional or classically trained artists who have approached the foot in a serious, analytical way, intent on understanding its anatomical forms and structural mechanics. Leonardo da Vinci was one such artist, writing that "the human foot is a masterpiece of engineering and a work of art." Leonardo understood that the foot is a complex biomechanical structure, able to withstand the enormous pressure placed upon it and to act as a lever to propel the body forward in space.

Many artists find the foot difficult to depict accurately, given how greatly its shape can alter depending on the perspective. In front views, the foot has a wedge shape; in lateral (profile) views, a slightly elongated triangular shape; and, when viewed from beneath, a curving, organic shape. The toes, while not as long or expressive as the fingers, have interesting shapes that contribute to the dynamics of the foot's structure and movement.

By studying the foot's basic shapes, you will begin to see how it continues the action of the leg, enhancing the whole form's rhythmic quality. And drawing live models in longer standing poses will show you how the foot serves as a solid base to maintain the figure's balance.

Opposite: **STUDY OF RELAXING FEET**

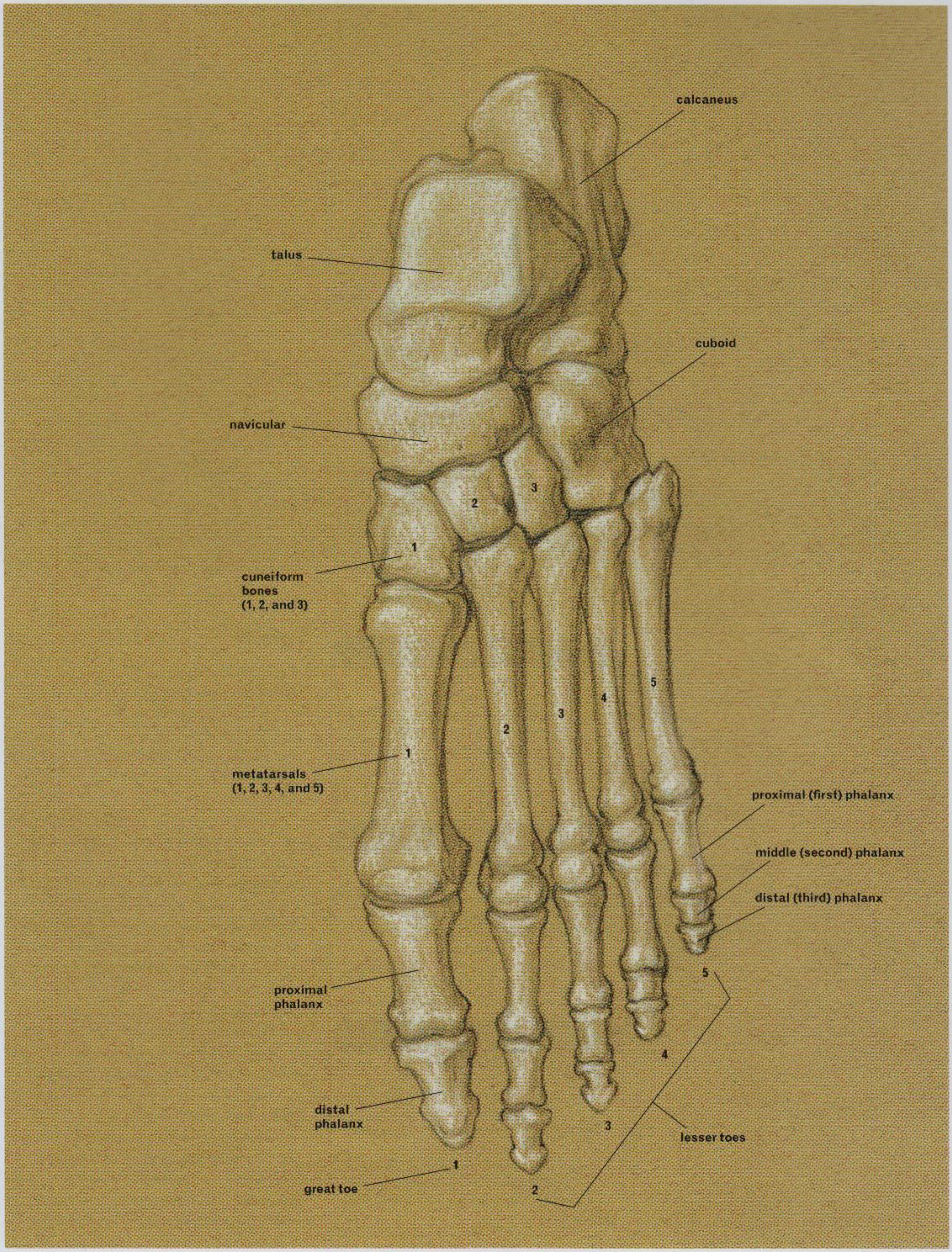
STUDY OF LATERAL VIEW OF THE FOOT

The Bones of the Foot

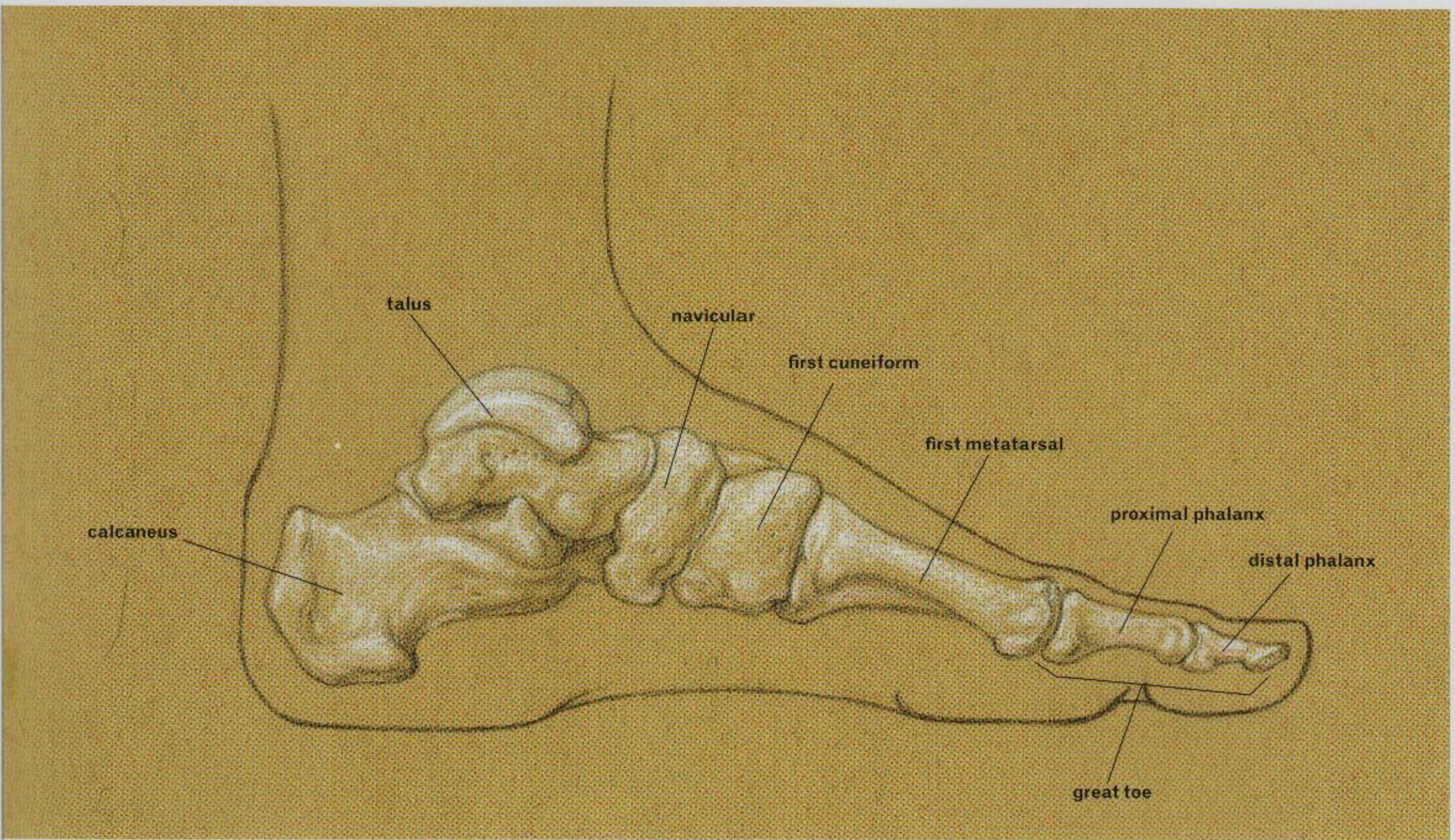
The bones of each foot consist of seven *tarsal* bones, five *metatarsal* bones, and a total of fourteen *phalanges* in the toes. The arrangement of these bones is somewhat similar to that of the bones of the hand. The tarsal bones, although larger, are similar to the carpal bones in that they function as shock absorbers and serve as attachment sites for ligaments and tendons. The metatarsals, which, like the metacarpals, are elongated bones, constitute the basic skeletal mass of the foot, along with some of the tarsal bones. The phalanges (toe bones), while smaller than the phalanges of the fingers, follow the same pattern, with the great toe having two phalanx bones (like the thumb) and the other toes having three phalanges each (like the fingers).

The bones of the foot can be divided into three anatomical segments: the *hindfoot,* which consists of the talus and calcaneus; the *midfoot,* which consists of the three cuneiform bones, the navicular, and the cuboid; and the *forefoot,* which consists of the five metatarsals and all the phalanges. Only small hints of these bones can be seen on the surface form, yet is important for artists to be aware of the foot's bony structure.

Although people have the same number of bones in their feet, slight variations in the bones produce different characteristics: Thick, short tarsal, metatarsal, and phalanx bones and a wide transverse arch (the arch spanning the width of the foot) give a foot a broad, stocky appearance; longer bones produce a more tapered and slender foot.



BONES OF THE FOOT (SUPERIOR VIEW, LEFT FOOT)



BONES OF THE FOOT
Medial view of left foot

Tarsals

PRONOUNCIATION
TAR-sols

ORIGIN OF THE TERM
Late Latin *tarsus* = instep

SYNONYMS
ossa tarsi (TA),
ossa tarsalia (TA), tarsales

Metatarsals

PRONOUNCIATION
MET-ah-TAR-sol

ORIGIN OF THE TERM
Greek *meta* = after
+ Late Latin *tarsus* = instep

SYNONYMS
ossa metatarsi (TA), ossa metatarsalia
I-V (TA), os metatarsale

Phalanges

PRONOUNCIATION
fuh-LAN-jeez
(sing., *phalanx*: FAY-lanks)

ORIGIN OF THE TERM
Greek *phalanx* = line or flank of soldiers

SYNONYMS
ossa digitorum (TA),
phalanges digitorum pedis

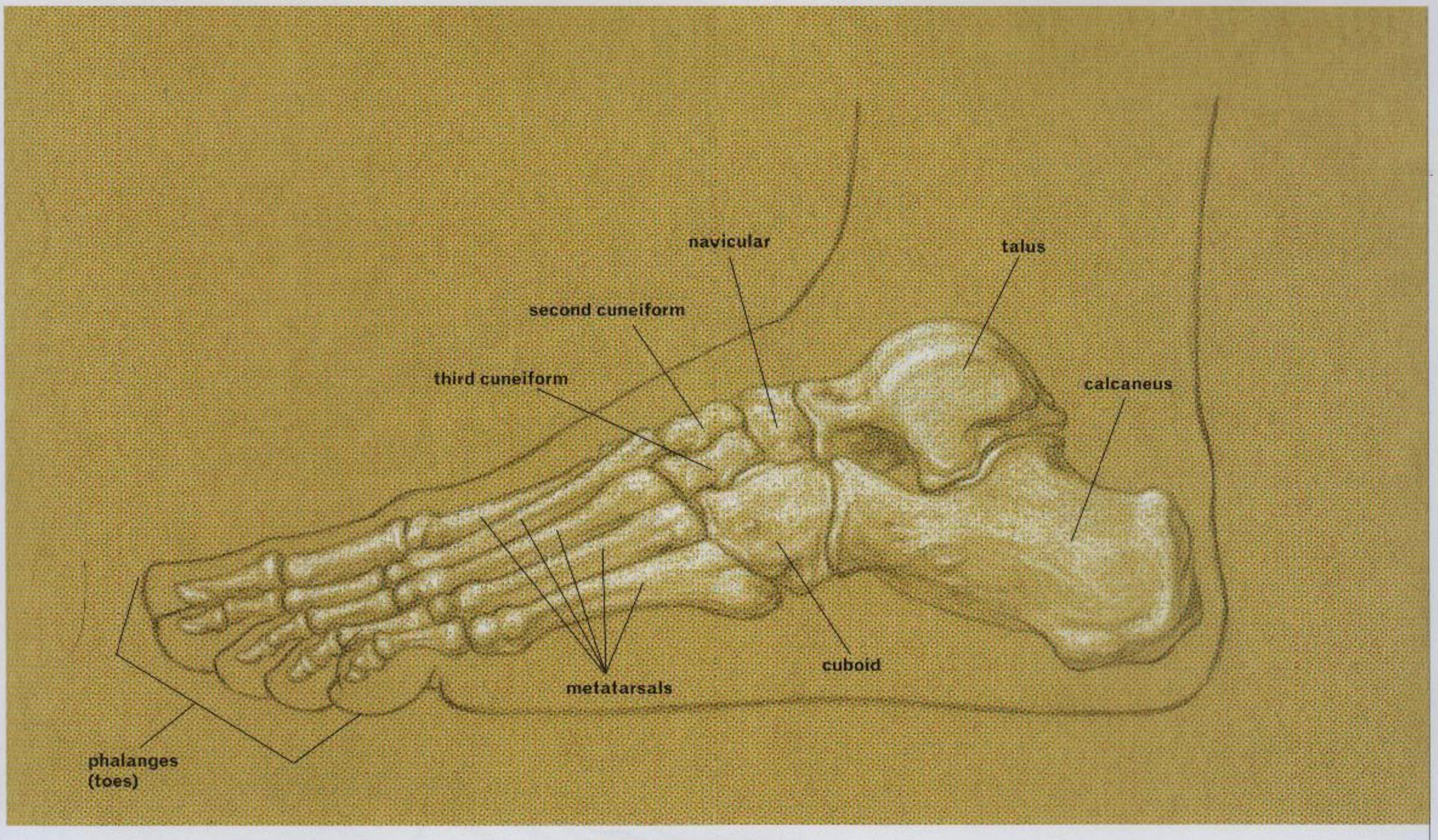
Tarsals

Located near the ankle joint, the bones called the tarsals serve as shock absorbers, much like the carpal bones of the wrist. As a group, these bones form the back and middle portions of the foot, while the metatarsals and phalanges form the front portion.

Like the carpals of the hand, the tarsals are arranged in two rows: a *distal row* and a *proximal row.* The proximal row, at the backmost portion of the foot, consists of the large *calcaneus* bone and *talus* bone. The distal row contains the three *cuneiform* bones and the *cuboid* bone. The *navicular* bone is positioned between these two rows and is therefore referred as the *intermediate bone.*

The largest tarsal bone, the calcaneus, is commonly known as the heel bone. Its bulky posterior projection—called the *calcaneal tuberosity*— forms the prominence of the heel, which is an attachment site for the Achilles tendon (calcaneal tendon) of the gastrocnemius and soleus muscles.

The talus is positioned above the calcaneus. The top portion of this bone contains a smooth semicylindrical form that articulates with the lower portion



BONES OF THE FOOT
Lateral view of left foot

of the tibia and fibula to create the ankle joint. The particular shapes of these three bones (tibia, fibula, and talus) allow for the hinge-like movements of the foot called dorsiflexion and plantar flexion. The talus is the only tarsal bone that has no muscular attachments.

The remaining five tarsals are sometimes referred to as the *anterior tarsal bones* because of their position in front of the calcaneus and talus.

The three cuneiform tarsals are small, wedge-shaped bones. These bones look like finely chiseled stone blocks that have been placed against each other in a precise arrangement. The first, known as the *medial cuneiform* (or *first cuneiform*), is positioned on the medial side of the foot and is the largest of the three. The second, which is the smallest, is called the *middle cuneiform* (or *second cuneiform*). The third is called the *lateral cuneiform* (or *third cuneiform*).

The cuboid bone is positioned next to the lateral cuneiform on the outer side of the foot. The navicular bone is located near the inner arch of the foot, in front of the talus bone and behind the three cuneiforms.

The tarsal bones are connected by various bands of ligaments. The joints between the tarsals are plane joints able to produce limited gliding movements when the foot must adjust its position on uneven surfaces or other precarious terrain.

Metatarsals

The five metatarsals are elongated bones that extend from the anterior tarsal bones toward the region of the toes. These bones do not lie flat but (along with the tarsal bones) contribute to the overall structure of the arch of the foot.

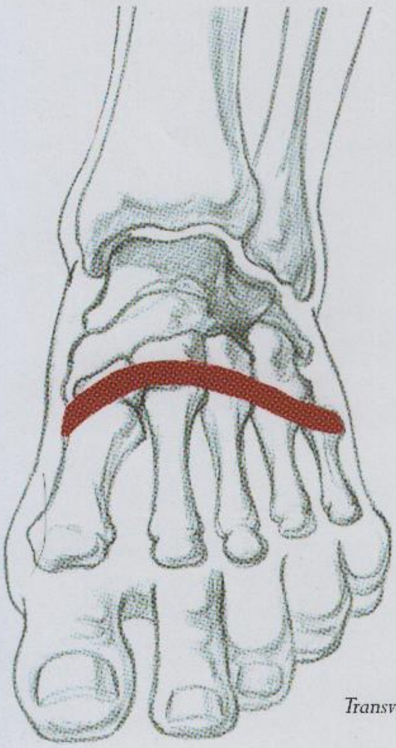
The metatarsal of the great toe (the *first metatarsal*) is the thickest and shortest. Its shaft can sometimes be seen on the surface as a slightly curving furrow. The joint between the first metatarsal and the proximal phalange of the great toe contributes to the very obvious surface form commonly called the *ball of the foot*.

Another surface landmark associated with the metatarsals is a slight bump, called the *tuberosity of the fifth metatarsal*, located on the lateral side of the foot at the base of the fifth metatarsal, approximately midway between the heel and the tip of the little toe. Sometimes this small bony bump is obscured by muscle and fibrous fatty tissue.

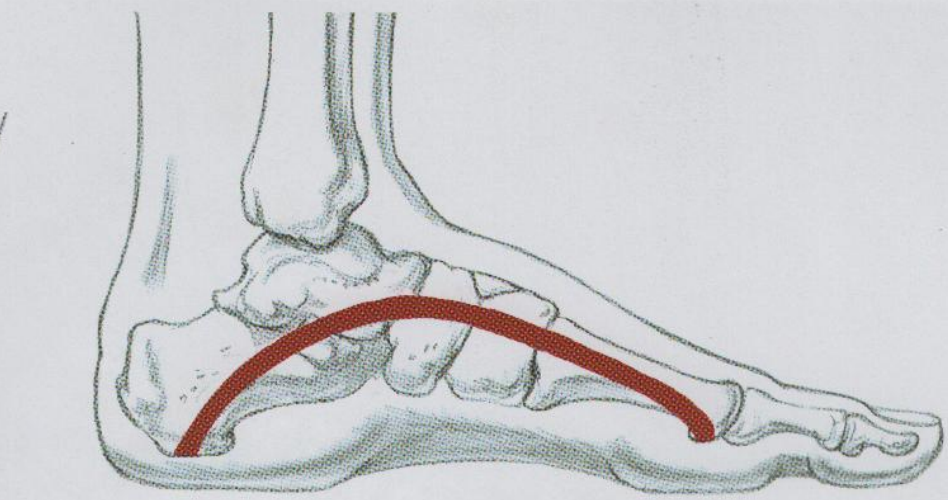
Phalanges

The phalanges of the toes have a pattern similar to that of the phalanges of the fingers (see page 185). The great toe, like the thumb, contains two phalanges, and the remaining toes (the *lesser toes*) have three phalanges each, like to the fingers of the hand. The biggest difference is that the phalanges of the four lesser toes are much shorter than those of the fingers.

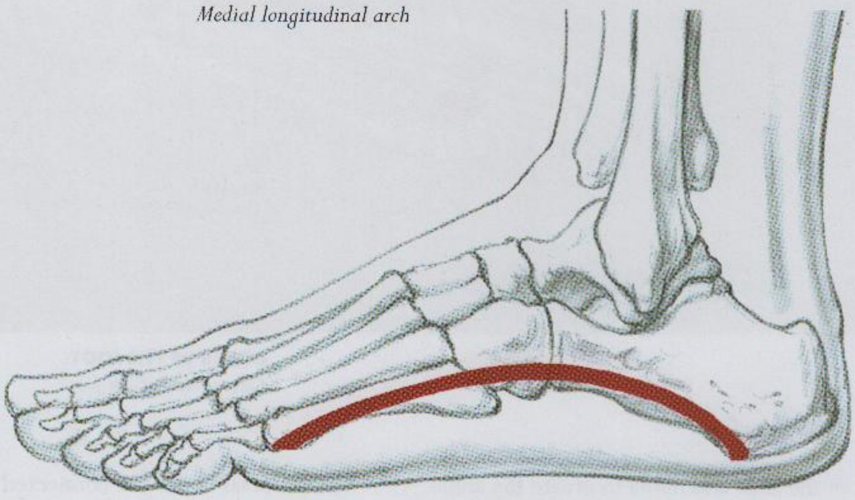
The great toe and second toe are the longest of the five toes. Toes 3, 4, and 5 tend to curl inward in a relaxed, flexed position, making them appear even shorter than they are.



Transverse arch



Medial longitudinal arch



Lateral longitudinal arch

THE THREE ARCHES OF THE FOOT

The Arches of the Foot

The structure of the foot includes three arches:

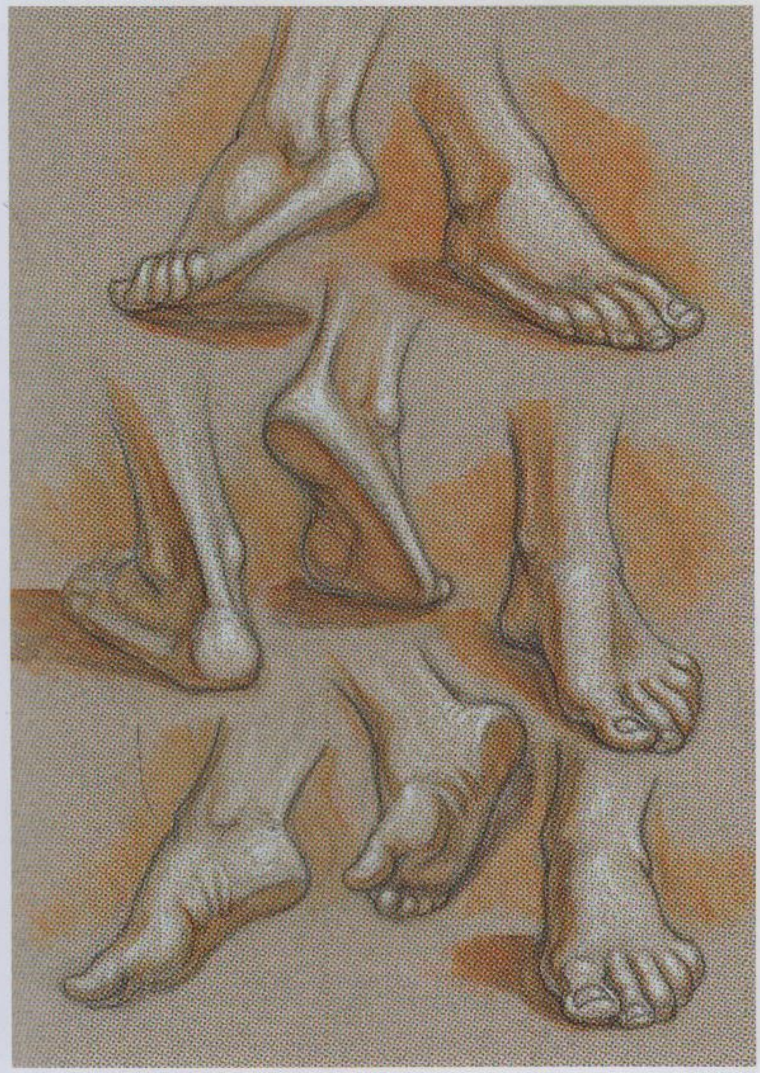
- The *medial longitudinal arch,* positioned along the inner length of the foot
- The *lateral longitudinal arch,* positioned along the outer length of the foot
- The *transverse arch,* positioned across the width of the foot

Built of bones, strong ligaments, and tendons, these arches absorb pressure and soften impact on the foot during movement and help distribute the weight of the body. They also help the foot adapt to different terrains, such as rocky paths or sandy beaches.

The medial longitudinal arch is the highest of the three and is positioned on the medial side of the foot. The calcaneus, the talus, the navicular, and the three cuneiform tarsal bones, as well as the first three metatarsal bones, form the medial arch. This arch is easily observed on the feet of ballet dancers and of people with naturally high arches because the central portion of the arch is lifted upward, above the floor or ground in a slightly exaggerated manner. In people with flat feet, however, the medial arch is much less pronounced, more or less following the ground along the inner length of the foot.

The lateral longitudinal arch is lower and flatter than the medial arch. Formed by the calcaneus and cuboid tarsal bones as well as the fourth and fifth metatarsal bones, this arch is not as evident on the surface because of the abductor digiti minimi muscle and the fibrous/fatty tissue that covers the outer length of the foot.

The span of the transverse arch runs perpendicular to the longitudinal arches. Formed by all three cuneiform bones, the cuboid, and the bases of all five metatarsals, this arch is higher on the medial side of the foot, dropping down lower as it crosses over to the lateral side. Anatomically, this arch runs directly beneath the bones and is not on the top of the foot, but it is more beneficial for artists to visualize the transverse arch as extending across the width of the foot on the upper (dorsal) side. This arch is most easily seen in front views of the foot.



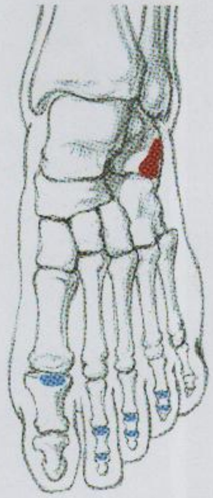

Left: **MULTIPLE FOOT STUDIES**
Right: **FOOT RESTING ON PILLOW**

The Muscles of the Foot

The muscles of the foot include both the *intrinsic muscles of the foot,* which are short muscles that attach directly on the bones of the foot, and the long tendons of the *extrinsic muscles of the foot,* which originate on the tibia or fibula of the lower leg.

The intrinsic muscles of the foot include four layers. Three of these layers are mostly contained within the *plantar* region (the sole of the foot) and are difficult to see on the surface form because they are obscured by fatty tissue and fascia. Therefore, only the first layer, the most superficial—and most visible—of the foot's intrinsic muscles will be discussed here.

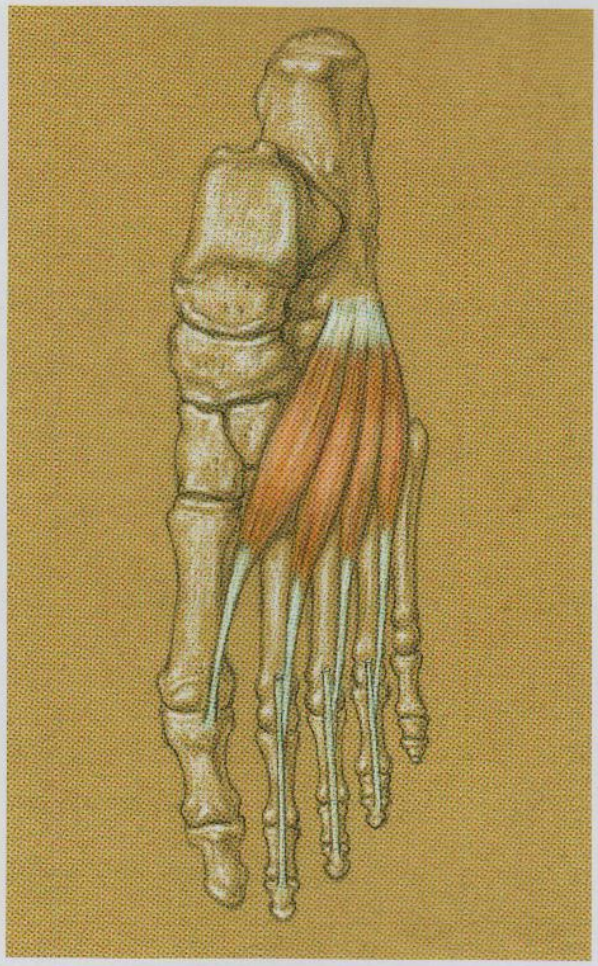
On the dorsal side (top) of the foot, only one muscle is somewhat visible on the surface form—the *extensor digitorum brevis* (the short extensor of the toes). Along the medial side of the foot is the *abductor hallucis* (the abductor of the great toe); running parallel to it along the lateral side is the *abductor digiti minimi* (the abductor of the little toe). The most superficial muscle of the plantar region is the *flexor digitorum brevis* (the short flexor of the toes).



EXTENSOR DIGITORUM BREVIS—MUSCLE ATTACHMENTS

ORIGIN
- calcaneus (upper and lateral surface)
- inferior extensor retinaculum

INSERTION
- phalanges of toes 1–4



EXTENSOR DIGITORUM BREVIS (SUPERIOR/DORSAL VIEW, LEFT FOOT)

Extensor Digitorum Brevis

PRONOUNCIATION
ek-STEN-sor dij-ih-TOR-um BREV-iss
or
ek-STEN-sor dij-ih-TOR-um BREH-viss

ORIGIN OF THE TERM
Latin *extendere* = to stretch out + *digitorum* = pertaining to the digits (toes) + *brevis* = short

SYNONYMS
musculus extensor digitorum brevis (TA), extensor brevis digitorum pedis, extensor brevis digitorum, short extensor of the toes

Extensor Digitorum Brevis

The extensor digitorum brevis is the only intrinsic muscle that is evident on the surface form of the dorsal (top) side of the foot. This small muscle begins on the front portion of the calcaneus bone, near the lateral side of the foot. The muscle has four fleshy bellies, which create a soft, subtle mound on the surface form. The four tendons extending from these bellies insert into the great toe and the first three lesser toes.

Some authorities consider the first fleshy belly of the extensor digitorum brevis to be a separate muscle, which they call the *extensor hallucis brevis* (short extender of the great toe). Its tendon inserts into the base of the proximal phalanx of the great toe, near the more obvious long tendon of the extensor hallucis longus (long extensor of the great toe), which originates on the tibia.

Abductor Hallucis

The abductor hallucis muscle forms the inside margin of the foot. It attaches on the medial part of the calcaneus and travels along the medial arch of the foot toward the great toe, where it inserts. This muscle is sometimes evident as a soft bulge on the medial side of the foot near the heel.

Abductor Digiti Minimi

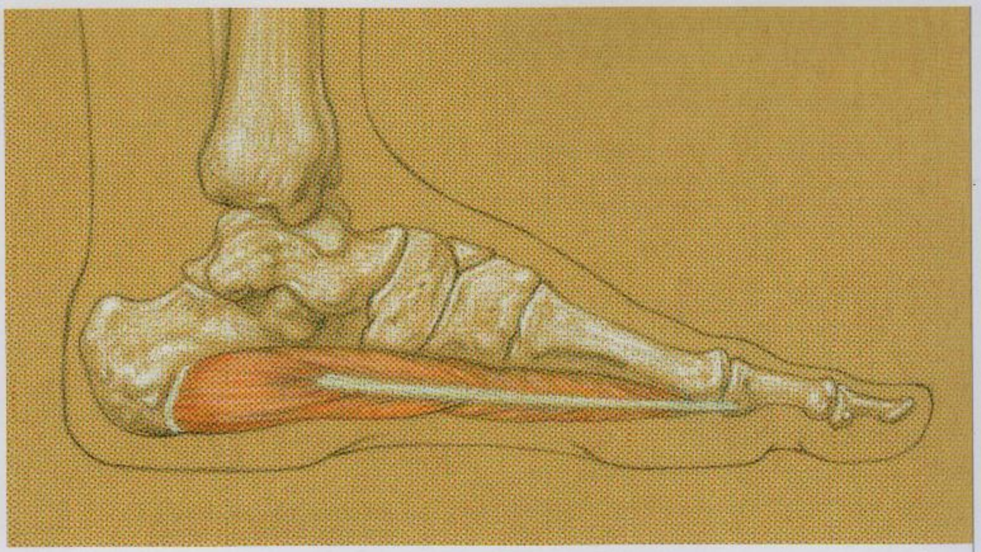
The abductor digiti minimi is a long muscle that is positioned on the outer margin of the foot. It begins underneath the calcaneus and travels to the base of the fifth metatarsal, then continues on to the base of the proximal phalanx of the little toe, its tendon obscured by the fleshy muscle fibers. This muscle can be seen as a thin ledge that extends from the little toe toward the mass of the heel. A plane change occurs from the upper arch (transverse arch) of the foot to the more elongated angular ledge of the abductor digiti minimi. Sometimes light seems to catch along its top border, making it easier to see. This muscle is padded along the sole by fatty tissue.

Abductor Hallucis

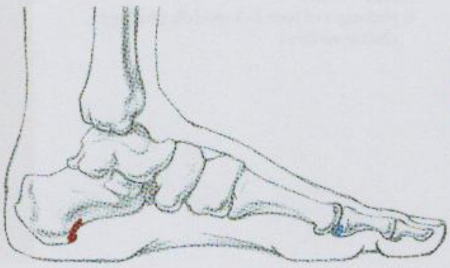
PRONOUNCIATION
ab-DUCK-tor HAL-loo-siss
or
ab-DUCK-tor HAL-luc-kiss

ORIGIN OF THE TERM
Latin *abducere* = to lead or take away
+ *hallux* = great toe

SYNONYMS
musculus abductor hallucis (TA),
abductor of the great toe (big toe)



ABDUCTOR HALLUCIS (MEDIAL VIEW, LEFT FOOT)



ABDUCTOR HALLUCIS—MUSCLE ATTACHMENTS

ORIGIN
- calcaneus (calcaneal tuberosity, medial process)
- plantar aponeurosis

INSERTION
- phalanx of great toe (base of proximal phalanx, medial side)

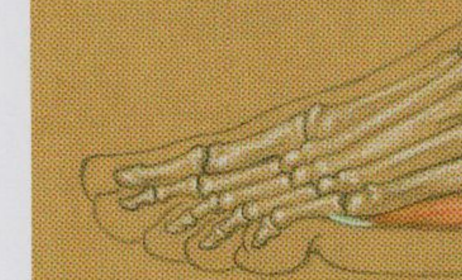
Abductor Digiti Minimi

PRONOUNCIATION
ab-DUCK-tor DIH-jih-tee MIN-ih-mee
or
ab-DUCK-tor DIJ-ih-tie MIN-ih-my

ORIGIN OF THE TERM
Latin *abducere* = to lead or take away
+ *digitus* = digit (toe) + *minimi* = smallest

SYNONYMS
musculus abductor digiti minimi (TA),
abductor digiti minimi pedis,
abductor of the little toe

ABDUCTOR DIGITI MINIMI (LATERAL VIEW, LEFT FOOT)



ABDUCTOR DIGITI MINIMI—MUSCLE ATTACHMENTS

ORIGIN
- calcaneus (calcaneal tuberosity, lateral process)
- plantar aponeurosis
- fifth metatarsal (base, tuberosity)

INSERTION
- phalanx of little toe (base of proximal phalanx, lateral side)

Flexor Digitorum Brevis

PRONOUNCIATION
FLEK-sor dij-ih-TOR-um BREV-iss
or
FLEK-sor dij-ih-TOR-um BREH-viss

ORIGIN OF THE TERM
Latin *flectere* = to bend + *digitorum* = pertaining to the digits (toes) + *brevis* = short

SYNONYMS
musculus flexor digitorum brevis (TA), perforatus, flexor brevis digitorum, short flexor of the toes

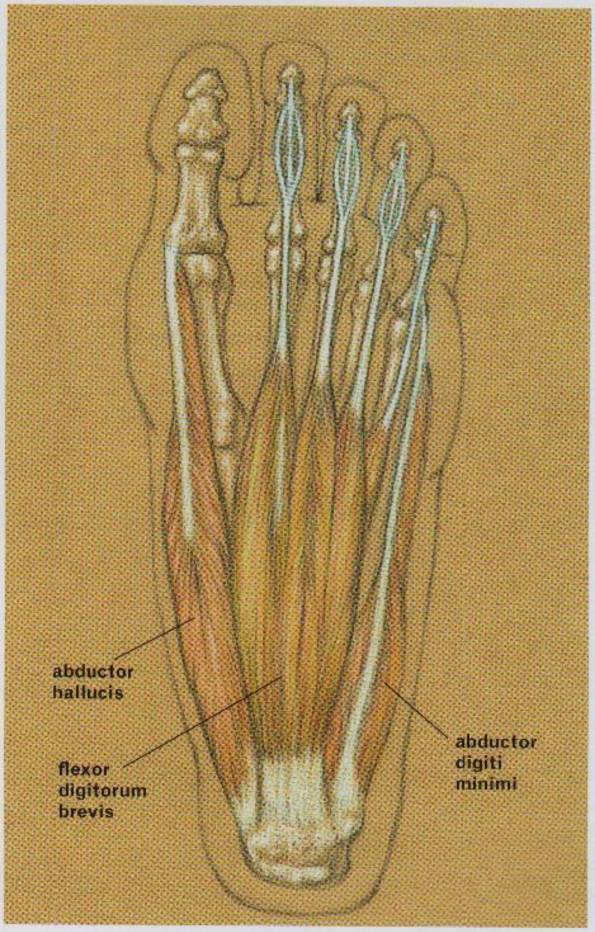
Flexor Digitorum Brevis

The flexor digitorum brevis, which is the most superficial of all the plantar muscles, occupies the central region of the sole of the foot. Its spindle-shaped belly begins on the calcaneus and on part of the plantar aponeurosis (fascia). About midway down the length of the foot, it divides into four tendons, which insert into toes 2 through 5 on the plantar side. Each tendon splits to pass around the tendon of the flexor digitorum longus (not shown) as it inserts into the middle phalanx of each toe. Because the flexor digitorum brevis is directly under the plantar aponeurosis and fatty padding, it is hard to distinguish its form on the surface.

FLEXOR DIGITORUM BREVIS—MUSCLE ATTACHMENTS

ORIGIN
- calcaneus (calcaneal tuberosity, medial and plantar surface)
- plantar aponeurosis

INSERTION
- phalanges of toes 2–5 (middle phalanges, plantar surface)



FLEXOR DIGITORUM BREVIS (INFERIOR/PLANTAR VIEW, LEFT FOOT)

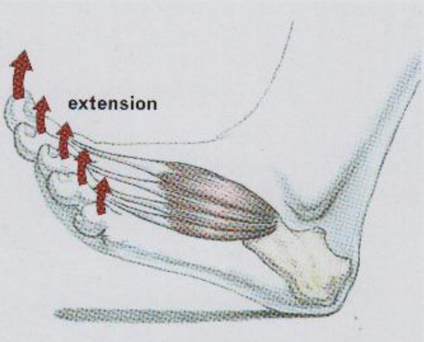
The Action of the Muscles of the Foot

The extensor digitorum brevis helps extend (straighten) the toes from a flexed (bent) position. It is activated in walking and in any other movement in which the toes are pulled upward. The extensor hallucis brevis extends the great toe.

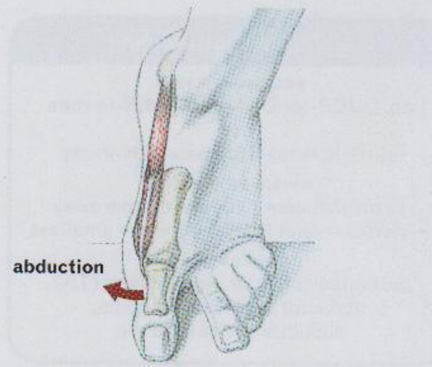
The abductor hallucis muscle assists in the action of abducting the great toe, pulling it away from the medial line of the foot.

The abductor digiti minimi abducts the little toe, pulling it sideways away from the foot, and it also helps flex (bend) the little toe.

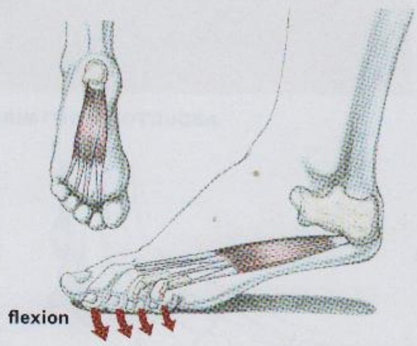
The flexor digitorum brevis, positioned on the sole of the foot, primarily flexes the lateral four toes at the proximal inter-phalangeal joints. This muscle is activated in walking and running as well as when the toes grip a surface for stability.



Extensor hallucis brevis and extensor digitorum brevis: extension of toes



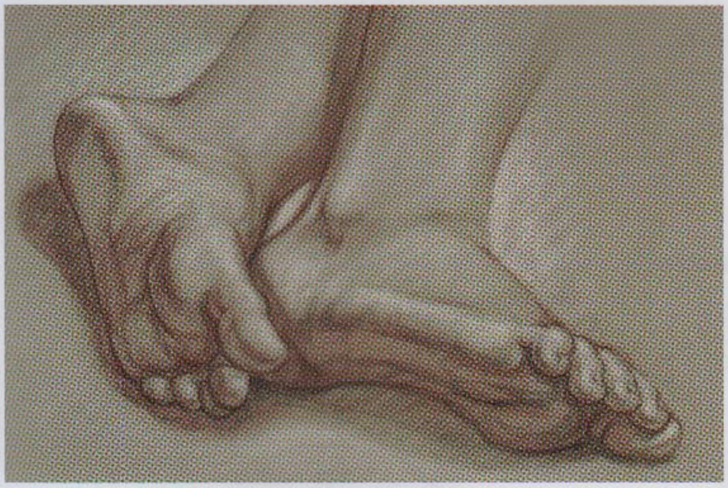
Abductor hallucis: abduction of great toe



Flexor digitorum brevis: flexion of toes 2–5

Abductor digiti minimi: abduction of little toe

FOOT MUSCLES—ACTION

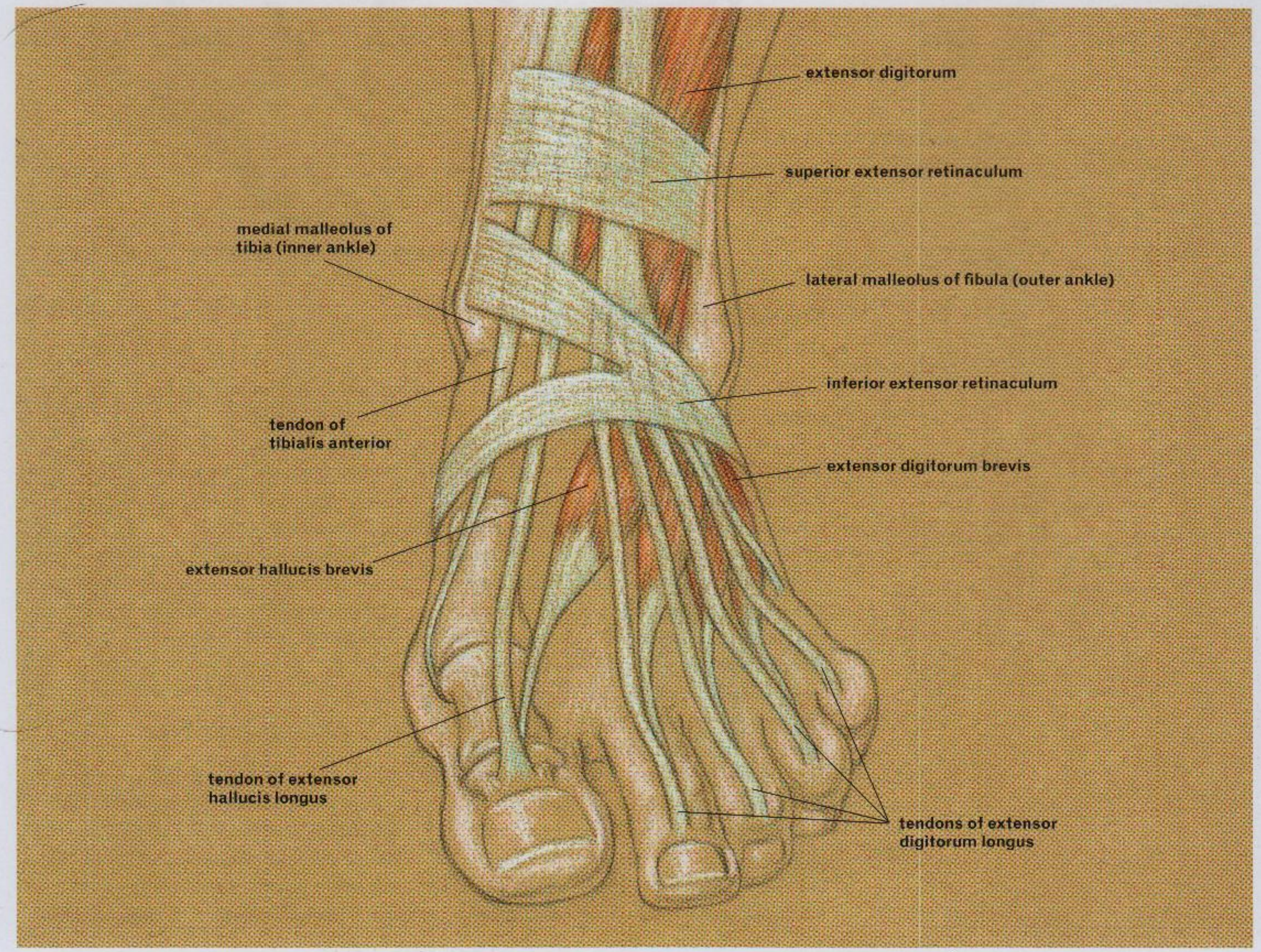


STUDY OF TWO FEET

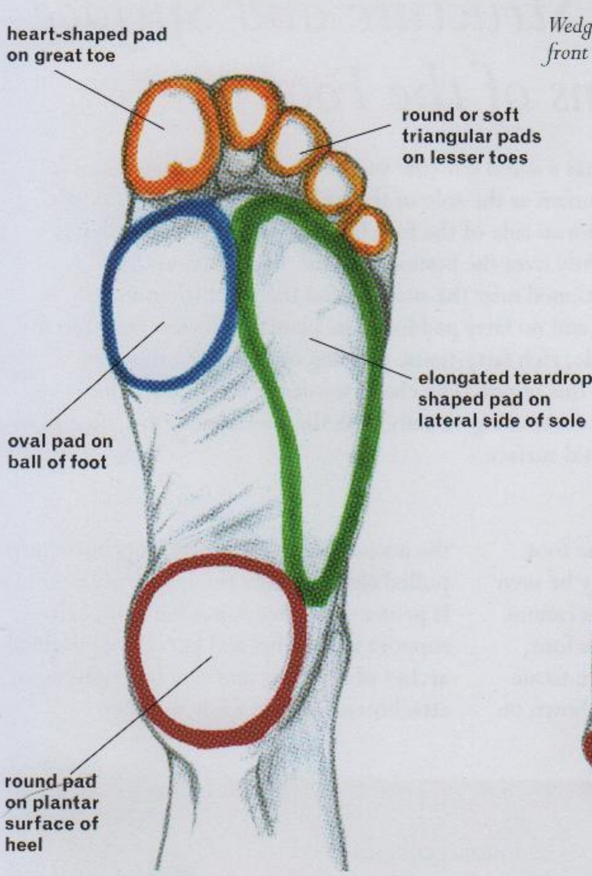
The Structure and Surface Forms of the Foot

The foot has a *dorsal side* (the top of the foot) and a *plantar side* (usually known as the sole of the foot). Like the hand's dorsal side, the dorsal side of the foot is streamlined: The thin skin is pulled tightly over the bones, tendons, fibrous bands, and veins positioned near the surface, and there is little muscle definition and no fatty padding. The plantar side is very different: On the sole, rich fatty-tissue padding obscures the muscles located in this region. The character of the sole is also more "organic," contrasting visually with the more geometric quality of the dorsal surface.

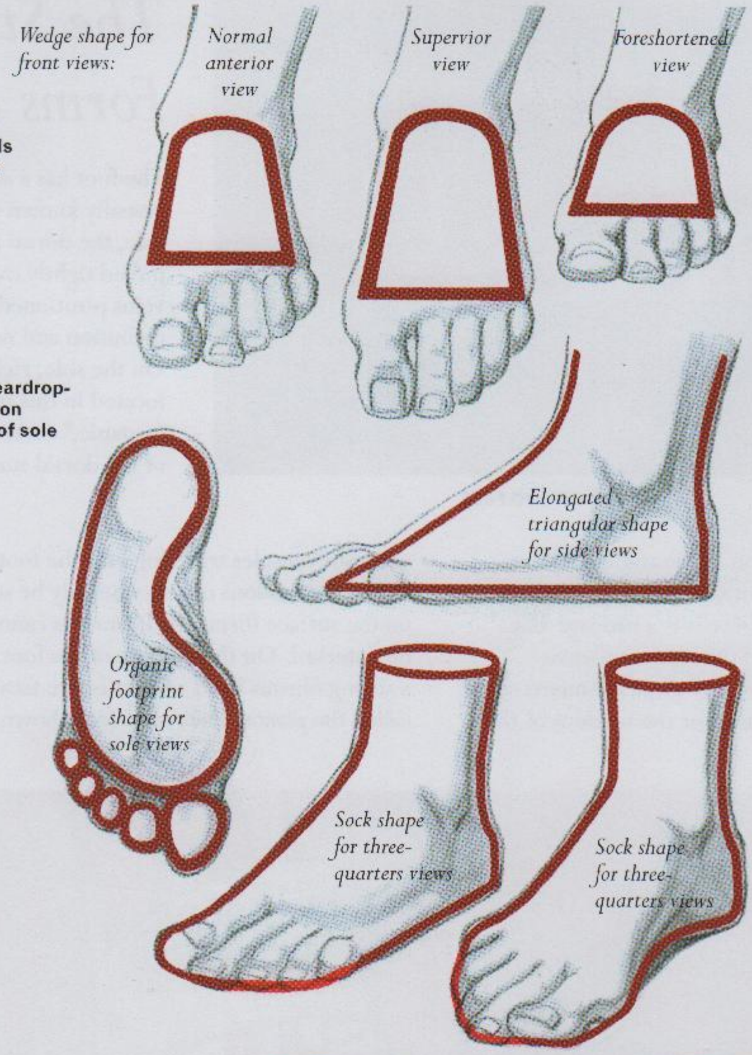
At the region of the ankle is a Y-shaped ligament called the *inferior extensor rectinaculum*; above it is a bandage-like ligament called the *superior extensor rectinaculum*. Both of these ligaments serve as retaining bands for the tendons of the extensor muscles traveling into the foot. While the tendons can occasionally be seen on the surface form, the ligaments cannot be detected. On the bottom of the foot, a strong fibrous band of connective tissue called the *plantar aponeurosis* (not shown on the accompanying drawing) acts like a tarp pulled tightly across the length of the sole. It protects the structures beneath, helps support the medial and lateral longitudinal arches of the foot, and also functions as an attachment site for a few muscles.



DORSAL SIDE OF FOOT—STRUCTURES (ANTERIOR VIEW, LEFT FOOT)



FOOT PADS (PLANTAR SURFACE, LEFT FOOT)
Characteristics of padding on sole of foot



STRUCTURAL SHAPES OF THE FOOT (DIFFERENT VIEWS)

The Sole of the Foot and the Foot Pads

The sole of the foot contains a great amount of fibrous fatty tissue, which serves as protective padding for the heel, the ball of the foot, the lateral portion of the sole, and the bottom tips of the toes. It is this padding that gives the sole of the foot its basic shape and unique character.

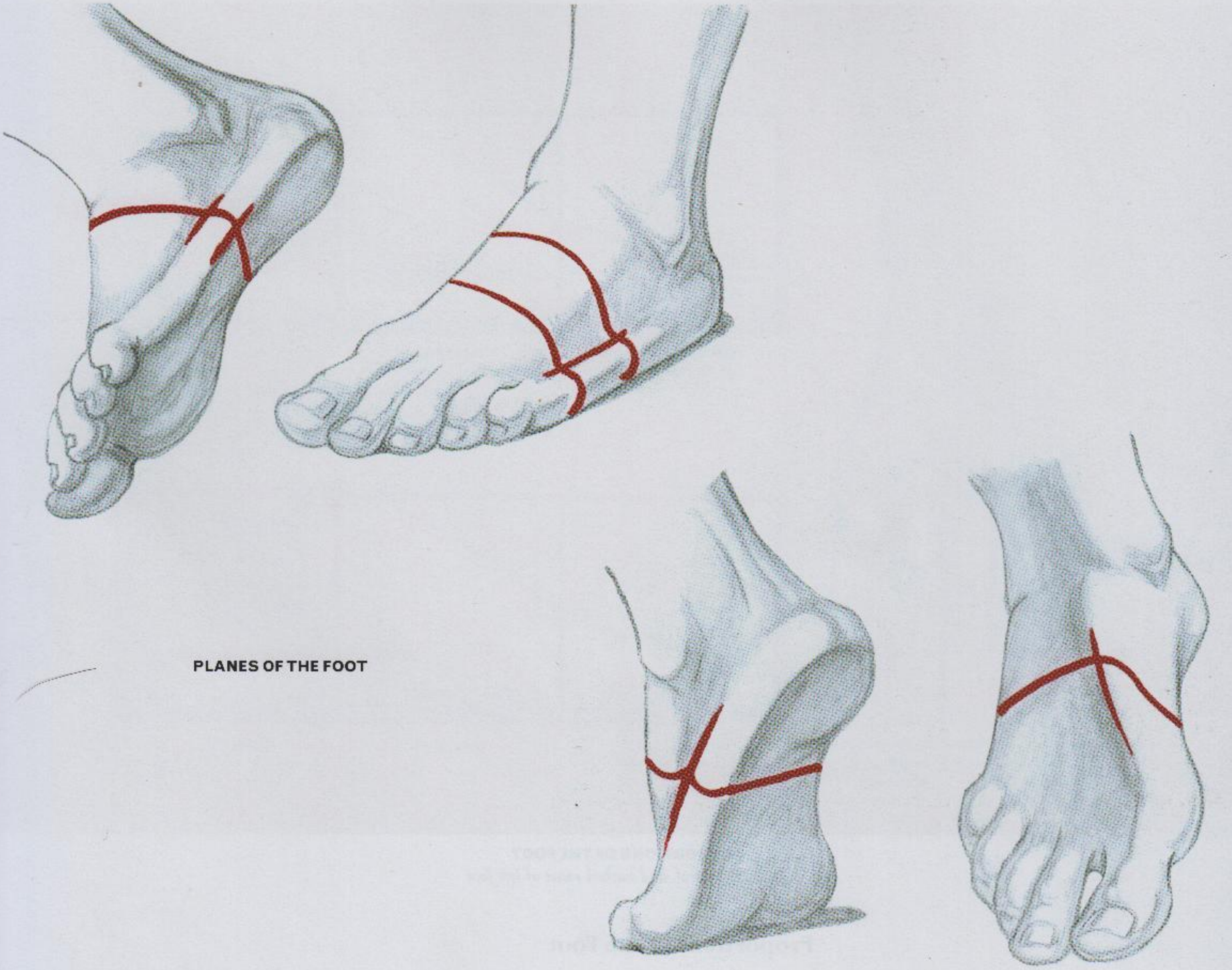
The heel pad has a round shape; that on the ball of the foot is oval in character; and the pad on the lateral side of the sole is an elongated teardrop shape. The great toe's pad is heart shaped, and the pads of the lesser toes are round (or may appear softly triangular in some poses).

The skin is of the sole is much thicker than the skin on the rest of the foot. A transitional zone between these two different thicknesses of skin encircles the entire outer foot, traveling along the foot's outer and inner margins, around each toe, and around the heel. The thicker skin of the sole is slightly lighter or different in color from the rest of the skin on the foot. This thick skin serves as a buffer against all the impact and pressure encountered by the foot.

There are several creases along the inside of the arch and the central portion of the sole. There are very few creases on the bottom of the heel.

Basic Form of the Foot

By observing the general shape of the foot in different views, you will be able to analyze how the forms of the toes, the ball of the foot, the heel, and the ankle bones are positioned in relation to the foot's overall structure. A lightly drawn



PLANES OF THE FOOT

shape of this structure will serve you as a quick armature for verifying the general proportions before you begin adding the details. This basic structural shape may be geometric, organic, or a combination of both, depending on the position of the foot. As you observe the foot, you will often perceive wedges, triangles, ovals, or blocks—sometimes combined with other shapes—among its forms. When sketching light underdrawings, try different shapes to see which ones work best for each view.

For front views, a wedge-like shape can be used for the region from the ankles down to where the toes begin. The length of this shape will alter according to perspective: When you can see more of the foot, an elongated wedge works well; when you see the foot from a more foreshortened angle, a "squashed" version of the wedge will be a better choice.

For profile views of the foot, you can use an elongated triangular shape as a quick armature before adding the details of the toes and other forms.

For three-quarter views of either the medial or lateral side, a simplified organic shape like that of a foot encased in a sock works well as a quick indication of the structure before the detail is added.

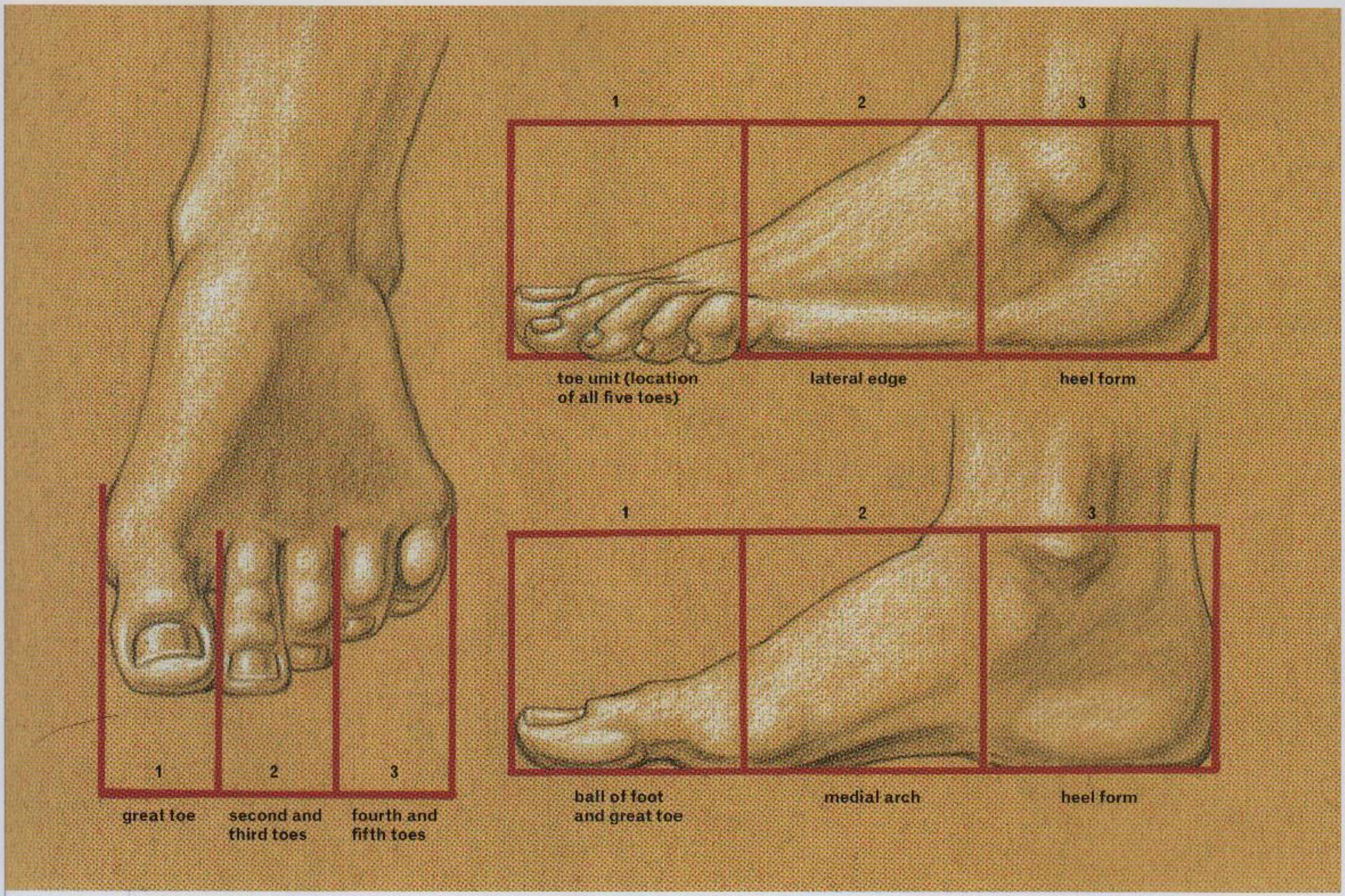
For views of the bottom of the foot, an organic shape resembling a footprint is an easy shape to draw quickly on paper.

Planes of the Foot

Once you have established the basic shape and structure of the foot, look for plane changes occurring across the foot's surface. These are most noticeable in the areas of the arches, such as where the medial (inner) arch is positioned next to the transverse arch on the dorsal part of the foot and from the dorsal part of the foot to the outer, ledge-like form along the lateral edge of the foot.

Views that include the bottom of the foot as well as part of the side of the foot often give you the opportunity to emphasize the planes by shading the sole of the foot in tone.

Plane changes in the toes can be emphasized with a subtle variation in values, with the top planes generally indicated in lighter values while the side and bottom portions are gently submerged in tone.



PROPORTIONS OF THE FOOT
Anterior, lateral, and medial views of left foot

Proportions of the Foot

The proportional breakdowns presented here are only a guide to estimating the foot's overall width and length and the locations of the various forms on the foot. This system works only for views of the foot in which no foreshortening is occurring.

The length of the foot from the tip of the great toe to the back of the heel is about equal to the length of the head from the top of the cranium to the chin. In a lateral view, the length of the foot can be divided into thirds: The first third contains the toes, the second third is the location of the ledge-like form of the abductor digiti minimi, and the last third is the location of the heel.

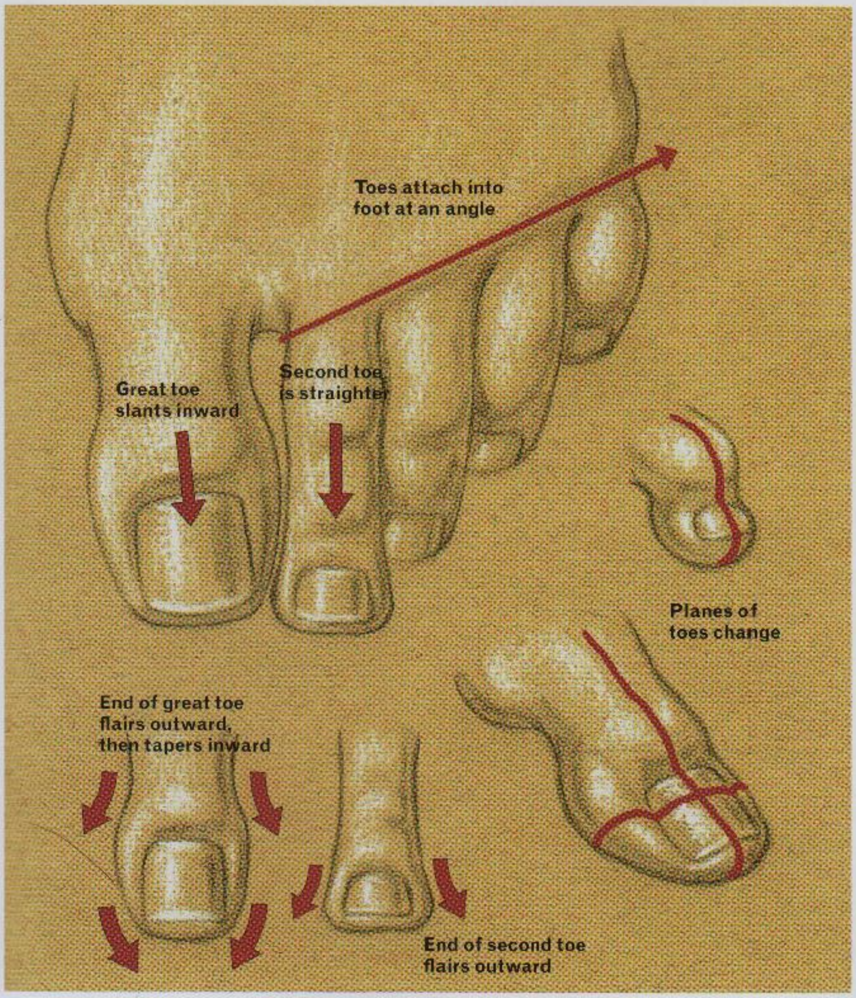
In a medial view, the first third contains the great toe and approximately half of the ball of the foot. The middle third contains the medial arch, and the last third, again, indicates the location of the heel.

In a front (anterior) view, the width of the foot at the toes can also be divided into thirds: The width of the great toe is approximately the same as that of the second and third toes together, which in turn is about the same as the fourth and fifth toes together.

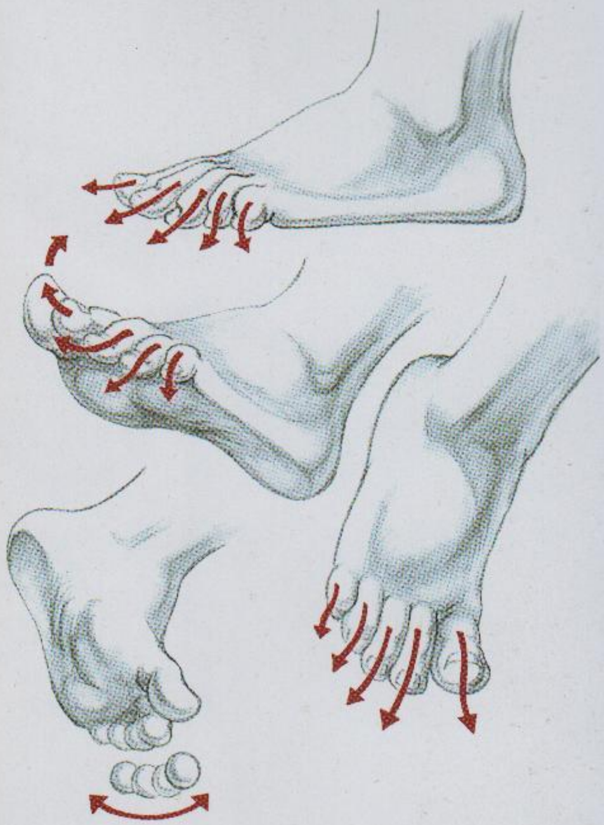
Characteristics and Rhythm of the Toes

The toes are easier to depict than the fingers, since they are not as long or complex in shape nor as nimble in movement. When you observe the toes carefully and learn some of their key characteristics, you will be able to convey the whole structure of the foot more convincingly.

The great toe, obviously, is the largest toe. Unlike the other toes, it has only two phalanges. On the fleshed-out foot, the proximal phalanx appears as a neutral cylindrical form, while the distal phalanx takes on a unique shape much like a snake



CHARACTERISTICS OF THE TOES



RHYTHM OF THE TOES
Rhythmic alignments in shapes and positions of toes

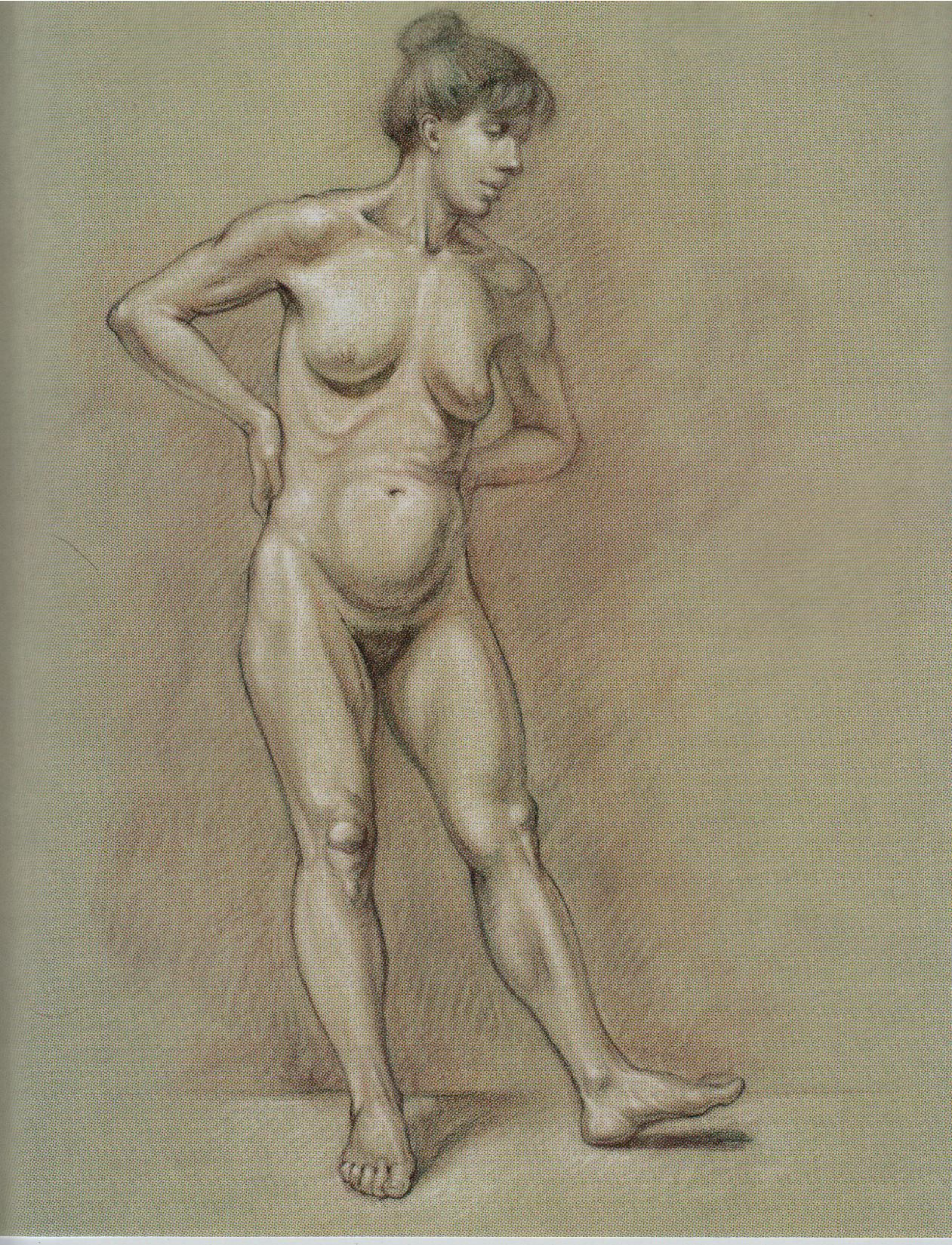
or lizard's head. At the joint between these two bones, the great toe flairs outward and then slightly tapers toward its tip. The nail of the great toe is usually wedge shaped or nearly square. Because of the great toe's hefty volume, its nail size is considerably larger than the nails of the four lesser toes. When the great toe tilts up or down, the nail curves around the top surface; it may appear as a crescent shape in foreshortened views of the foot.

When the foot is relaxed, without any toe movement, the great toe has a tendency to slant slightly inward toward the central axis of the foot.

The second toe, which is slender, is usually the same length as, or even somewhat longer than, the great toe. Classical artists tended to exaggerate the length of this toe to give the foot a more elegant and lyrical quality. The second toe is usually positioned more horizontally than the other lesser toes, making its three joints easier to see. The tip of this toe tends to flair outward rather than to taper. There is a slight gap between the great and second toes.

The third, fourth, and fifth toes are not just shorter than the great and second toes, but they also curl inward slightly, which makes them appear even smaller. With the extra padding of fatty tissue around their bottom tips, the last three toes can appear as short, soft cylindrical forms. The little toe appears almost like a bulbous little teardrop, showing no evidence whatsoever of the bones within.

When depicting the toes as a group, look for the rhythmic sense of movement in their relationship to one another, which will be slightly different in each pose, depending on the view. Because of the bulbous padding on their bottom tips, the four lesser toes can look like beads in a curving row, especially in depictions of the sole of the foot.



Chapter 8 The Whole Figure

In chapters 2 through 7, we looked at the various regions of the human body, systematically presenting the bones, muscles, and surface forms associated with each. Now, the challenge is to put all of these pieces of information together into a cohesive whole. There are many different ways of doing so, and some key approaches will be discussed.

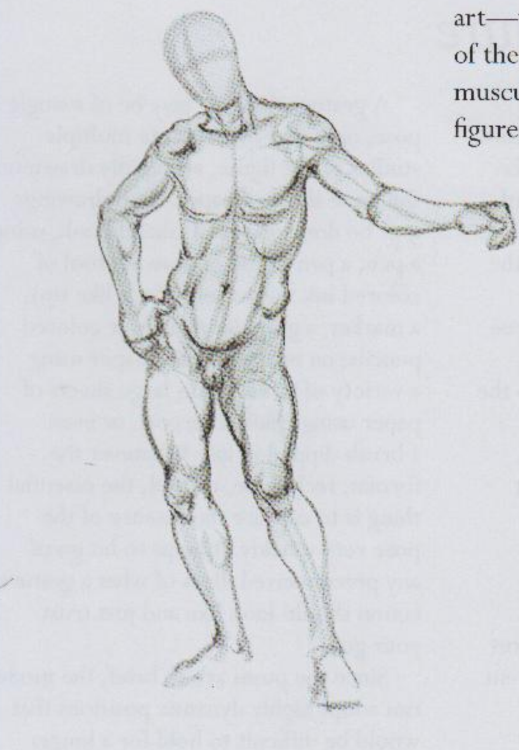
One of the most enjoyable ways to draw the whole figure is gesture drawing, which gives you the opportunity to capture the vitality of the entire pose in artistic "shorthand." Longer studies allow you to observe the structure of the whole figure within each pose more carefully, assessing the tilts, angles, rotations, and placements of individual body parts as you assemble them to depict the entire body.

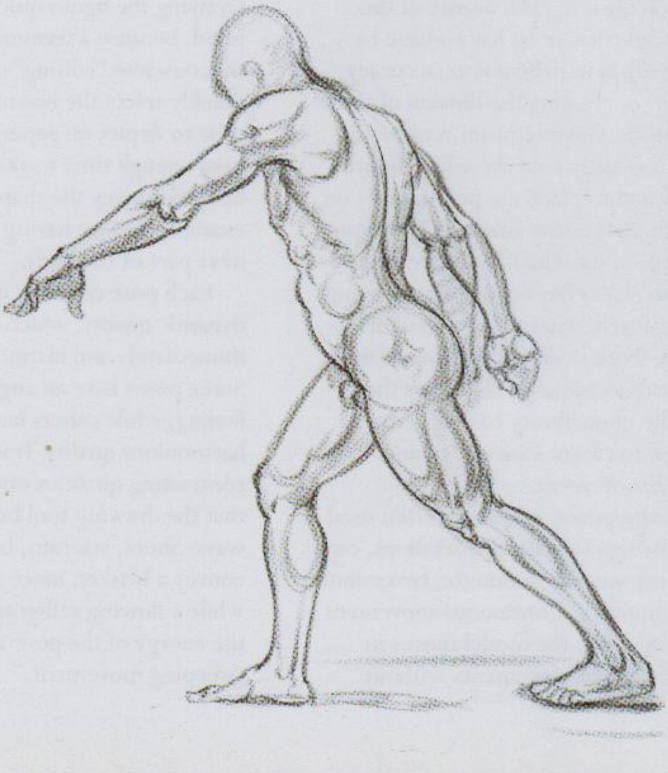
Through the application of different proportional systems, you'll be able check the lengths and widths of the various parts of the body and their relation to the length and width of the whole figure. Studying various body heights and body types—not just the athletic body types frequently used in figurative art—will give you a wider range of understanding regarding the complexity of the human form. And being aware of the rhythmic qualities in dynamic muscular forms will bring a feeling of cohesiveness and continuity to your figure drawings.

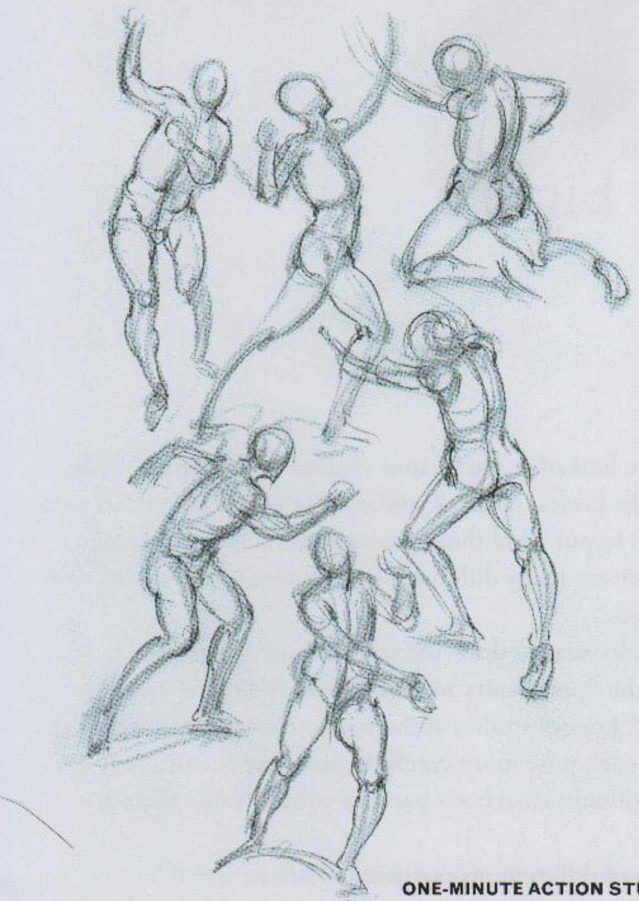
Opposite: **STANDING VIEW—FIGURE WITH ELBOWS OUT**

Below left: **FIVE-MINUTE STUDY OF MALE, FRONT VIEW**

Below right: **FIVE-MINUTE LEANING GESTURE POSE**







ONE-MINUTE ACTION STUDIES

ACTION STUDIES

Gesture / Action Drawing of the Figure

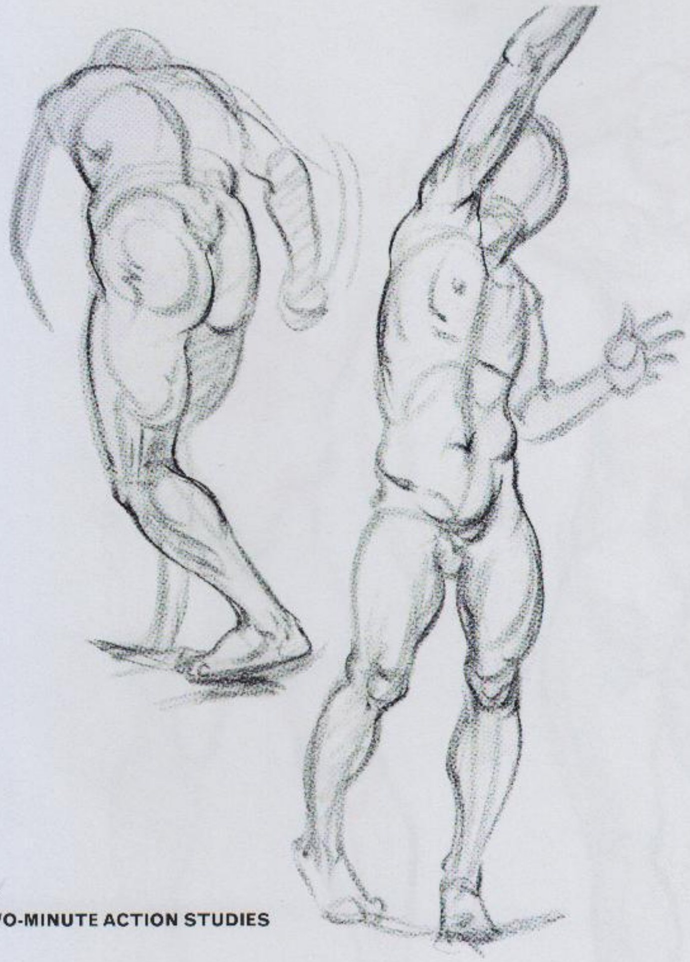
One way to approach the whole figure is through the practice of gesture drawing, or action drawing. The beauty of this approach is that artist has no time to pay attention to proportion, accuracy of form, or creating the illusion of three dimensions. Gesture poses require the artist to visually scan the whole figure quickly and to place the pose rapidly on paper in an intuitive manner. This type of approach (of which there are several methods) has a freeing quality, allowing the artist to become more spontaneous because there is simply no time to make analytical decisions. It also gives the artist the opportunity to exaggerate the pose to create a more dynamic sense of movement.

Gesture poses, which are often used in life-drawing classes and workshops, can last thirty seconds, a minute, two minutes, or five minutes. Continuous-movement poses, in which the model moves in slow, dancelike movements without stopping, provide another challenging way for artists to learn to capture gesture. Drawing the figure quickly sharpens the mind, because a tremendous amount of subconscious "editing" occurs as your eyes quickly select the essential aspects of the pose to depict on paper. You may only have enough time to sketch two or three lines to convey the shape of a leg, for example, before having to move on to the next part of the body.

Each pose contains its own unique, dynamic quality, which the mind must immediately and instinctively absorb. Some poses have an angular, agitated feeling, while others have a flowing, harmonious quality. Translating these contrasting qualities onto paper requires that the drawing tool be used in different ways: Short, staccato, broken lines convey a brisker, more tense action, while a flowing calligraphic line channels the energy of the pose into a more sweeping movement.

A gesture drawing may be of a single pose, or it may incorporate multiple studies of the figure, all rapidly drawn on the same sheet of paper. Such drawings may be done in a small sketchbook, using a pen, a pen-brush (a drawing tool of colored ink with a soft brush-like tip), a marker, a graphite pencil, or colored pencils; on medium-sized paper using a variety of tools; or on large sheets of paper using chalk, charcoal, or even a brush dipped in ink. Whatever the format, technique, or tool, the essential thing is to capture the essence of the pose very quickly. It helps to let go of any preconceived ideas of what a gesture action should look like and just trust your gut.

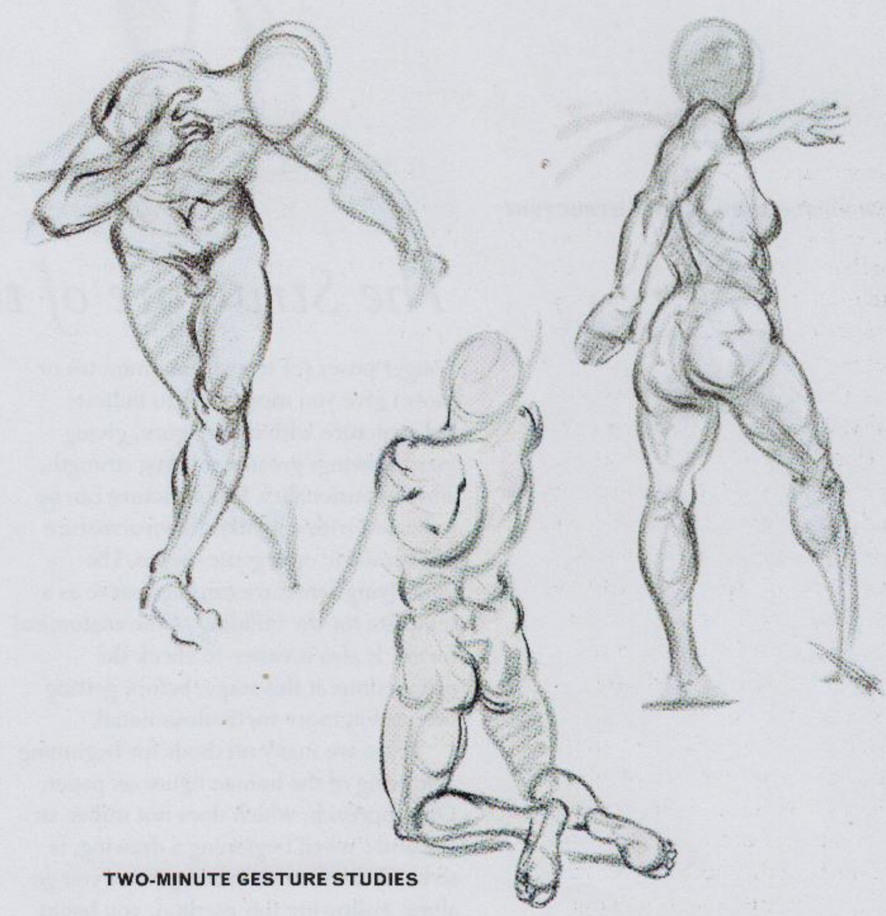
Since the poses are so brief, the model can adopt highly dynamic positions that would be difficult to hold for a longer time. Key elements to look for in these short action poses are the central axis of the whole figure, the angles of the



TWO-MINUTE ACTION STUDIES

shoulders and pelvis, and the basic, simplified shapes of the torso, head, and limbs. Remember that, in front views, the imaginary line of the central axis begins at the top of the cranium, travels down through the sternum and navel to the pubic bone, and continues down through one of the legs. In back views, the central axis begins at the top of the cranium and travels down along the spinal column, again continuing down through one of the legs. Once the central axis has been indicated, the rest of the figure—including the angles and tilts of the head, shoulders, hips, and limbs—can be quickly blocked in.

The key is to a successful gesture drawing is to keep the action fresh and spontaneous, with a feeling of vitality. If you slow down and focus too closely on one part of the figure, your drawing will lose its momentum, so it is essential to keep the drawing tool moving quickly.



TWO-MINUTE GESTURE STUDIES

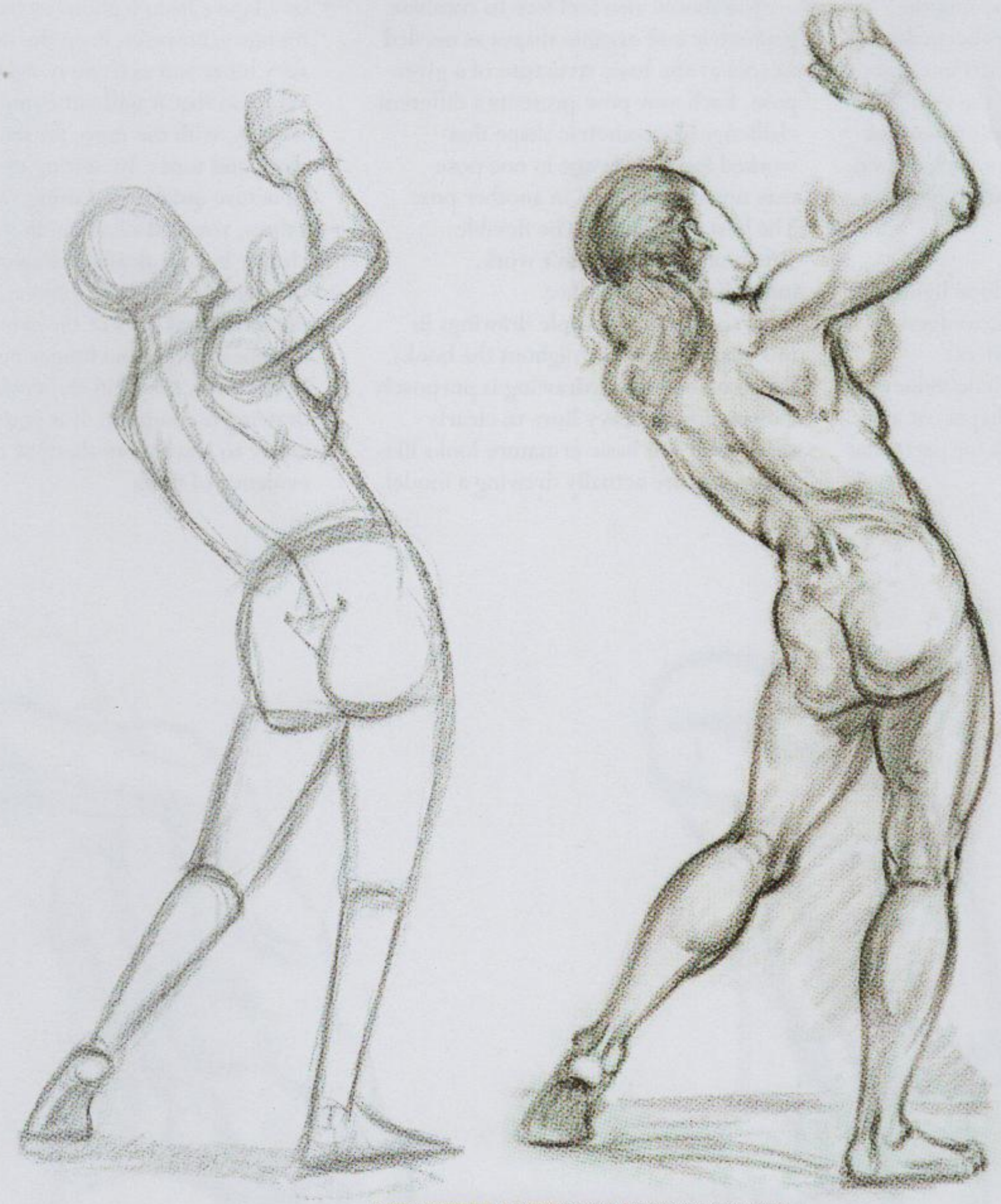
TWO QUICK STUDIES WITH STRUCTURE

The Structure of the Whole Figure

Longer poses (of ten to sixty minutes or more) give you more time to indicate the structure within the figure, giving your drawings greater solidity, strength, and dimensionality. The structure can be indicated with a lightly drawn armature of geometric or organic shapes. The underlying armature can then serve as a template for the building of the anatomical forms. It also is easier to check the proportions at this stage, before getting invested in more meticulous detail.

There are many methods for beginning a drawing of the human figure on paper. One approach, which does not utilize an armature when beginning a drawing, is to build the forms of the figure as you go along. Following this method, you begin on the blank sheet with a precise, slowly meandering calligraphic line that notes each surface detail as your eye scans the contour of the model (or photo source). In this approach, the structure of the figure slowly emerges as the details of the forms are selectively established. This way of drawing is, however, challenging, because the eye must always be looking ahead, evaluating where the line and tones will be placed without any reference except for what has already been drawn.

Another approach relies on first blocking in the planes of the figure and establishing the mid-value tones to roughly indicate where the shadows fall on the figure. Front planes, side planes, bottom planes, and top planes are



STRUCTURE AND FIGURE POSE, BACK VIEW

indicated in simplified shapes of lighter or darker tones. In this approach, the structure of the figure begins to emerge as the planes are carved out. After the basic shapes and planes are positioned on the page, the detail of the forms and the various gradations of value can be added. If you work on toned paper, the lights can be built up as the drawing develops or added after the basic shadows and deeper tones are established.

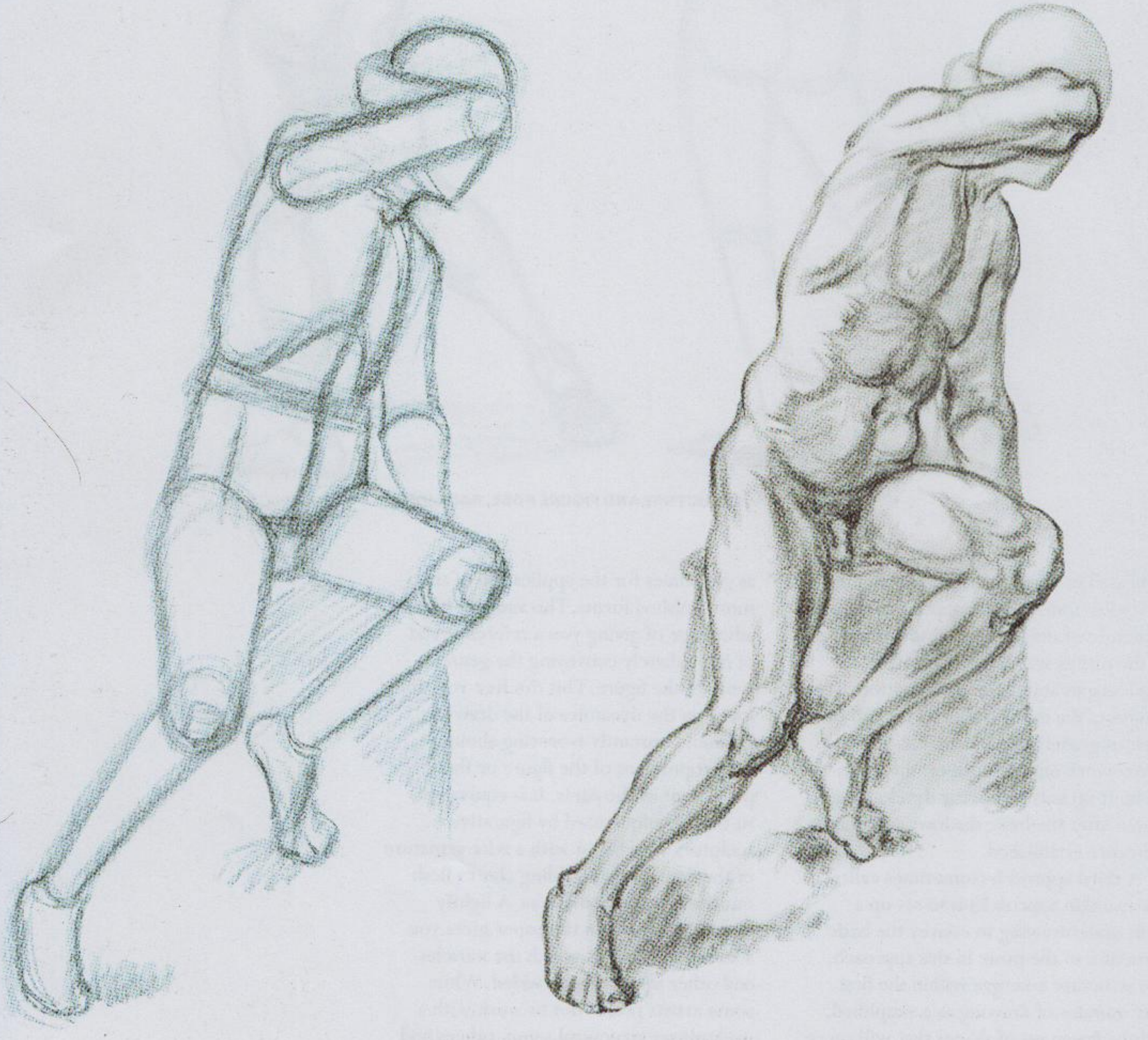
A third approach (sometimes called the manikin approach) is to set up a light underdrawing to convey the basic structure of the pose. In this approach, the structure emerges within the first few minutes of drawing as a simplified, lightly drawn set of shapes that will serve as guidelines for the application of the more finished forms. This method has the advantage of giving you a reference and of immediately conveying the general sense of the figure. This can free you to focus on the dynamics of the drawing without constantly worrying about the proportions of the figure or the placement of the parts. It is equivalent to the technique used by figurative sculptors who begin with a wire armature of the figure before adding clay to flesh out the muscles and forms. A lightly drawn armature on the paper gives you a structural base to which the muscles and other forms can be added. While some artists prefer not to work with a preliminary structural setup, others find it to be an invaluable aid in seeing the subtle or dynamic mechanics occurring in the pose, such as a spiral action of the torso or a subtle rotation of the arm. This approach also works very well when you are drawing from memory or imagination.

The structural shapes you choose to employ can vary:

- *Geometric shapes* might include lightly drawn rectangles, squares, wedges, blocks, triangles, or cylinders.
- Organic shapes might include kidney-bean shapes, ovals, pear shapes, or any freeform shapes that work for particular regions of the body.

You should also feel free to combine geometric and organic shapes as needed to convey the basic structure of a given pose. Each new pose presents a different challenge. A geometric shape that worked for the ribcage in one pose may not work as well in another pose. The best strategy is to be flexible: When one shape doesn't work, immediately try another.

In some of the sample drawings in this chapter (and throughout the book), the structural underdrawing is purposely indicated with heavy lines to clearly show what this basic armature looks like. When you are actually drawing a model or a figure from a photo or from memory, however, keep the underdrawing very loose and extremely light in value, so that it will not compete, visually, with the more finished line work and tones. By setting up the structure quickly and using very light values, you will avoid conflict and visual clutter in your finished drawing. After the finished lines and tones are applied, the structural lines of the armature will disappear or will no longer be noticeable. If, however, they still show when the drawing is complete, it is your choice either to leave them there or to erase any evidence of them.



STRUCTURE AND FIGURE POSE, FRONT VIEW

The Proportions of the Whole Figure

When putting the whole figure together, some consider it essential to make sure that the lengths and widths of the anatomical forms are proportional and that the forms are properly positioned. Although there are some artists who, for one reason or another, are not concerned with proportional considerations, many find a system of measurement very useful.

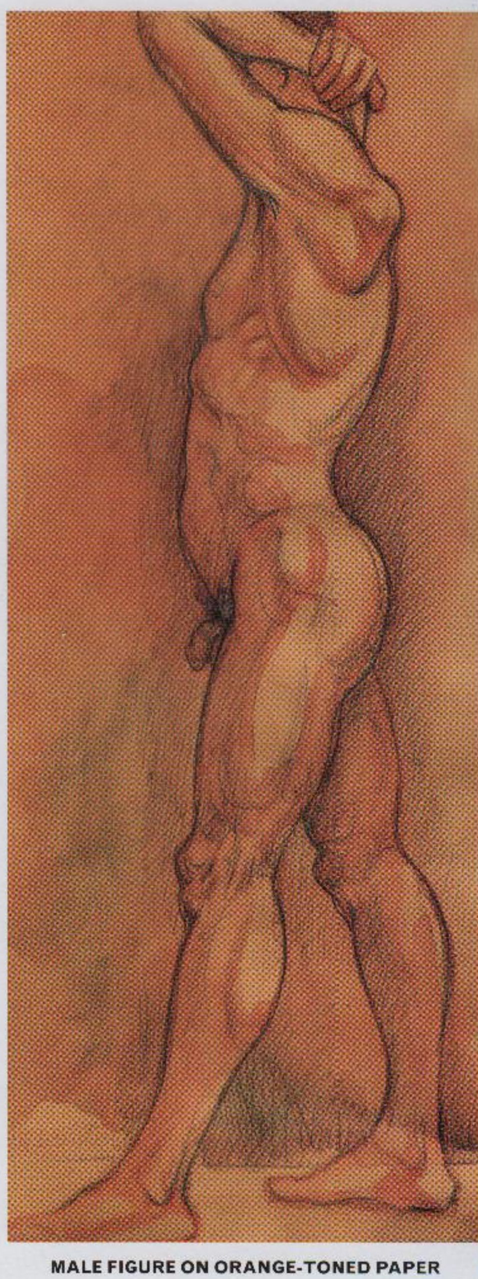
Since ancient times, artists have continually searched for an optimal proportional system that suits their need for a quick reference guide to the relative lengths and widths of the human body's parts. Looking at the figurative art of different cultures over the past few thousand years, however, one can see a tremendous variability regarding the correct proportioning of the figure. Often, this variability has had to do with what was fashionable in art at the time or what was acceptable to the ruling class or religious authorities. Some proportional systems have been utilized to depict the figure in a highly realistic way, while others have emphasized a more symbolic or spiritual interpretation of the body.

From historical evidence, it appears that ancient Egyptian artists investigated different systems of measuring the human body, although this had probably occurred in other, earlier cultures as well. Usually, a particular body part would be utilized as the basic measuring unit: Sometimes this was the hand, the foot, the forearm, or a finger, but the body part most commonly used as the unit of measurement was the head.

Ancient Greek sculptors used a measuring system based on the head, determining that, on average, the human body is seven and a half heads tall. The early Greek sculptor Polyclitus (fifth century BCE) was most likely the originator of the classical measuring system of seven and a half heads. Some later Greek and Roman artists modified the system, extending the body's length to eight heads to give additional height to the legs.

Systems of measuring bodily proportions came to be known as *canons.* (The term *canon* comes from the Greek *kanon,* from *kane* or *kanne,* meaning a reed or rod. In Latin, the word *canon* means a measuring line.) These canons of proportions were mathematical systems created to achieve a sense of harmony and balance among the various parts of the body and within the whole figure, producing an idealized beauty that was highly important to the classical artists. Many different canons of proportions were developed, but the systems based on seven and a half heads and eight heads were the most widely accepted.

After the fall of the Roman Empire, however, many of the concepts on which the classical interpretation of the human form was based went underground or were lost for hundreds of years. Not until the early Renaissance was some of this knowledge rediscovered. Artists such as Leonardo da Vinci and Albrecht Dürer began experimenting with the ancient canons, and other Renaissance artists developed their own proportional



MALE FIGURE ON ORANGE-TONED PAPER

systems, a few of which are still utilized by artists today.

Meanwhile, other, newer canons of proportions have been developed. Fashion designers and illustrators generally use a nine- or even a ten-head proportional system to accentuate the silhouette of the garments and to make the clothes appear more graceful or dynamic on the elongated figure. They also break down the length of the fashion figure into three sections, called thirds. The first third is from the head to the waist, the second third from the waist to the knees, and the last third from knees to the feet. Comic book artists drawing superheroes generally use a proportional system that exaggerates their figures' muscle bulk by making the figures taller and wider with comparatively small heads.

Why Learn a Proportional System?

The search for a perfect measuring system is rather futile, because proportions vary from person to person. Everyone's body does not fit into an idealized set of standards established by artists from long ago. All people are physically unique, with many differences—some subtle, some obvious—distinguishing each person from everybody else. It can therefore be frustrating trying to pigeonhole any adult person into a preconceived system of measurement.

Also, proportional systems of measurement do not necessarily work for every pose. Some of the landmarks for alignments are soft-tissue forms (such as the navel, the gluteal fold, and the nipple forms), which can be unreliable since their positions can change slightly in poses where there is stretching or compressing.

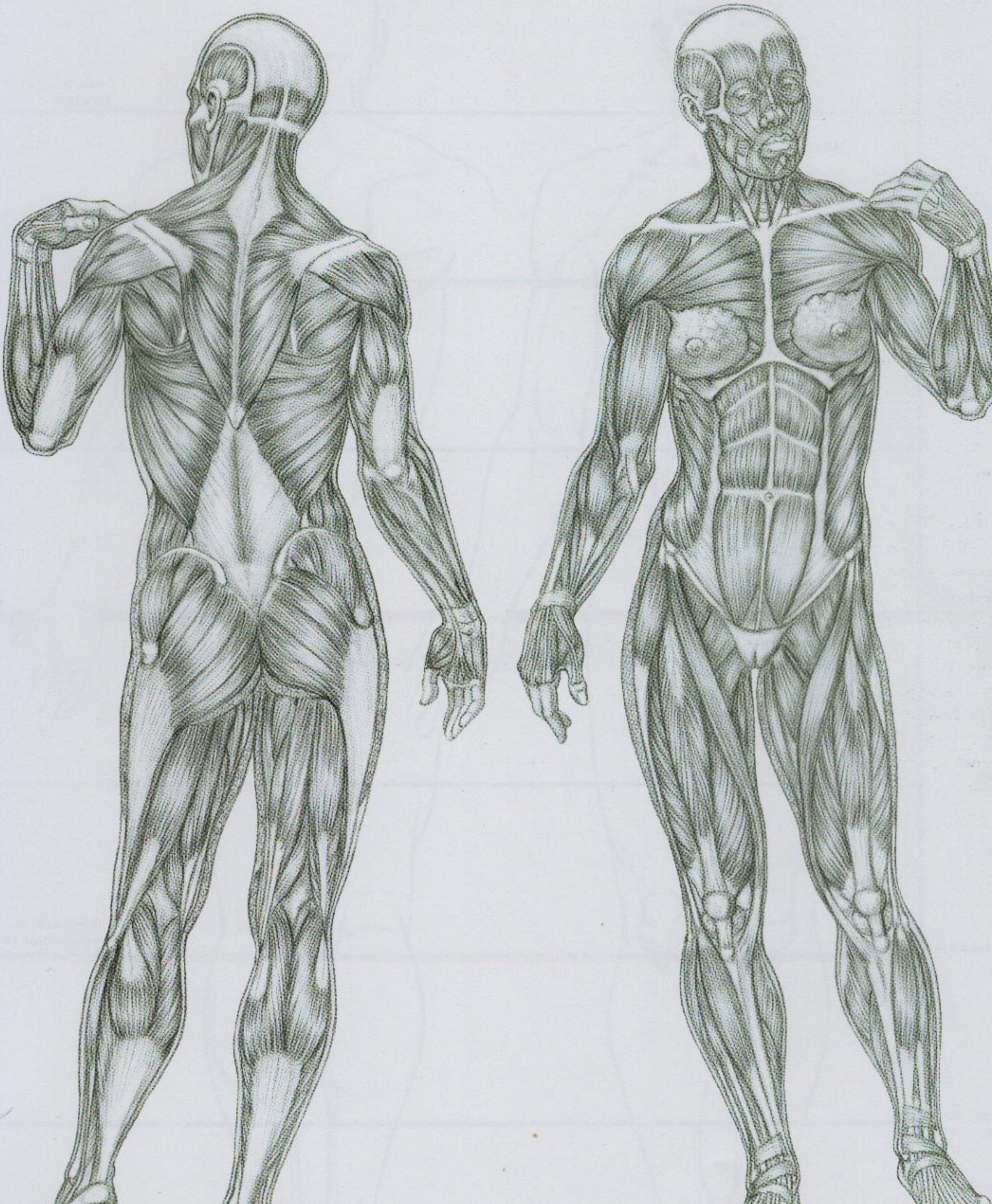
So why should you even bother learning a system of proportional measuring? For one thing, adopting and utilizing such a system can help you quickly identify the distinctive qualities of the figure you are depicting. Are his legs longer than those of the so-called average person? Is her waist higher or lower than what is considered normal? Having determined the ways in which the actual person varies from the canon, it is then up to you, the artist, to decide whether to accentuate the figure's unique characteristics or to stylize the forms into a more idealized form.

Knowing a proportional system can also help when you are drawing a figure from memory or imagination, allowing you to evaluate whether a figure is in proportion (if that is your intention). The real value of any proportional system, in other words, is that it gives you a general reference guide for assessing the relative lengths and widths of the human body's components and the ways that the various parts relate to each other. At best, proportional systems should be taken with a grain of salt—and used flexibly. You should also try a number of different proportional systems to see which is most suited to your own artistic approach.

The Standard Canons of Proportion

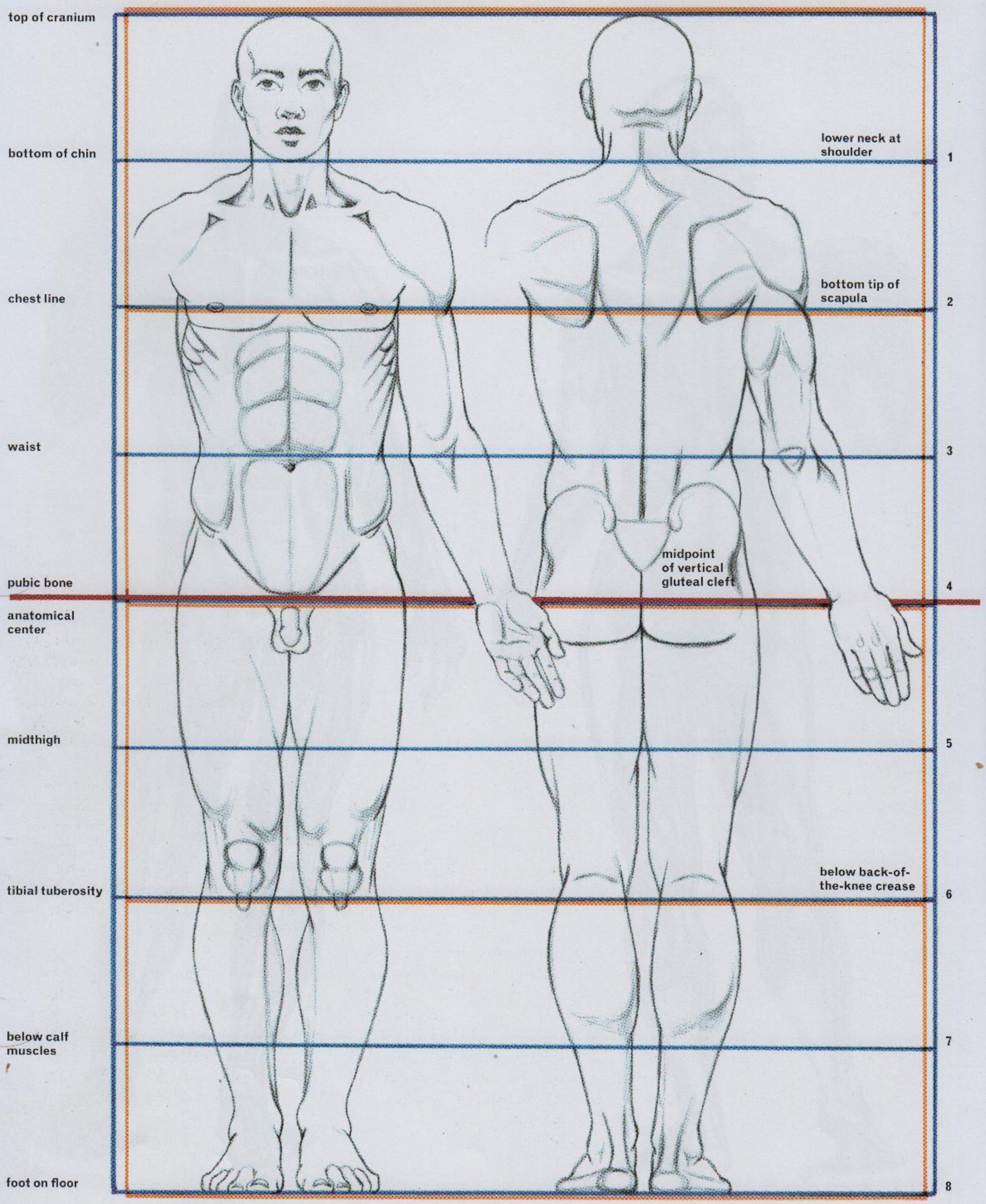
The proportional canons presented here are the standard, "garden variety" systems: the eight-head system and the seven-and-a-half-head system, as well as a system that divides the body into regions and then subdivides those into halves or thirds rather than relying on the head as a unit of measurement.

Older traditions required that the artist first check the proportions of the model, then mark off the proportional lines on a blank sheet of paper, then recheck the accuracy of those lines against the model, and, finally, fit the figure within the proportional markings established on the paper. That kind of procedure can be tedious, but it can serve you well if you are spending several hours on a single drawing. For shorter poses, it is best to start off with a quick, lightly drawn armature for the pose, trusting your own vision to evaluate the general lengths and widths, and then to check it proportionally, adjusting anything that looks off before adding the details. These proportional systems can, by the way, be applied to any female or male figure.



THE WHOLE FIGURE (ÉCORCHÉ FEMALE FIGURE)

Left: Posterior view. Right: Anterior view.



PROPORTIONAL SYSTEM USING EIGHT HEADS

The Eight-Head Proportional System

The eight-head system gives a slightly more elongated form to the overall figure. After lightly blocking in a quick structure of the pose, begin to check the proportions. Start checking the proportions of the model (or photo source) by measuring the head with a pencil or other long tool (from where you are sitting), and take that measurement all the way down the model's body. Then do the same with your drawing: Measure the length of the head of the figure in your drawing and lightly mark off the proportional lines. As you do so, continually check these measurements against the model being observed, making adjustments as necessary. Now proceed with the drawing, fleshing out the anatomical forms and other details. Since it is relatively rare to find a real person who is actually eight heads high, it is up you to exaggerate the length of the model's legs in your drawing to accommodate the eight-head proportional system.

The proportional breakdowns for the eight-head system are as follows:

1. For the front view: from the top of the cranium to the bottom of the chin. For the back view: from the top of the cranium to the lower neck, near the shoulders.
2. For the front view: from the bottom of the chin to the chest line (the nipple line on men, above the nipple line on women). For the back view: from the lower neck, near the shoulders, to slightly above the bottom tip of the scapula bones.
3. For the front view: from the chest line to the waist line (below the thorax, above the navel). For the back view: from slightly above the bottom tip of the scapula bones to the waist line.
4. For the front view: from the waist line to the pubic bone. For the back view: from the waist line to below the midpoint on the vertical gluteal cleft (slightly below the sacral triangle). (Note that the anatomical center of the figure is located at the public bone, greater trochanter, and midpoint of the vertical gluteal cleft.)
5. For the front view: from the pubic bone to the midthigh. For the back view: from below the midpoint on the vertical gluteal cleft to the midthigh.
6. For the front view: from the midthigh to the tibial tuberosity (the small bump on the tibia below the kneecap/patella). For the back view: from the midthigh to below the back-of-the-knee crease.
7. For the front view: from the tibial tuberosity to below the calf muscles (gastrocnemius). For the back view: from below the back-of-the-knee crease to below the calf muscles.
8. For front and back views: from below the calf muscles to the sole of the foot placed flat on the floor.

Another way to check proportions using this system is to divide the eight-head-long figure into quarters, from the top of the head to the chest line, the chest line to the pubic line (anatomical center), the pubic line to below the knees (the tibial tuberosity), and below the knees to the floor.

The Seven-and-a-Half-Head Proportional System

Traditionally, more artists have used the proportional canon of seven and a half heads than the eight-head system. Some artists think, however, that the seven-and-a-half-head system can make the figure look a bit too stocky, especially in the legs.

First, lightly block in the overall structure of the pose on paper, and then check the proportions on the model (or photo source). Then verify the proportions of the figure in your drawing and compare the model and the drawing.

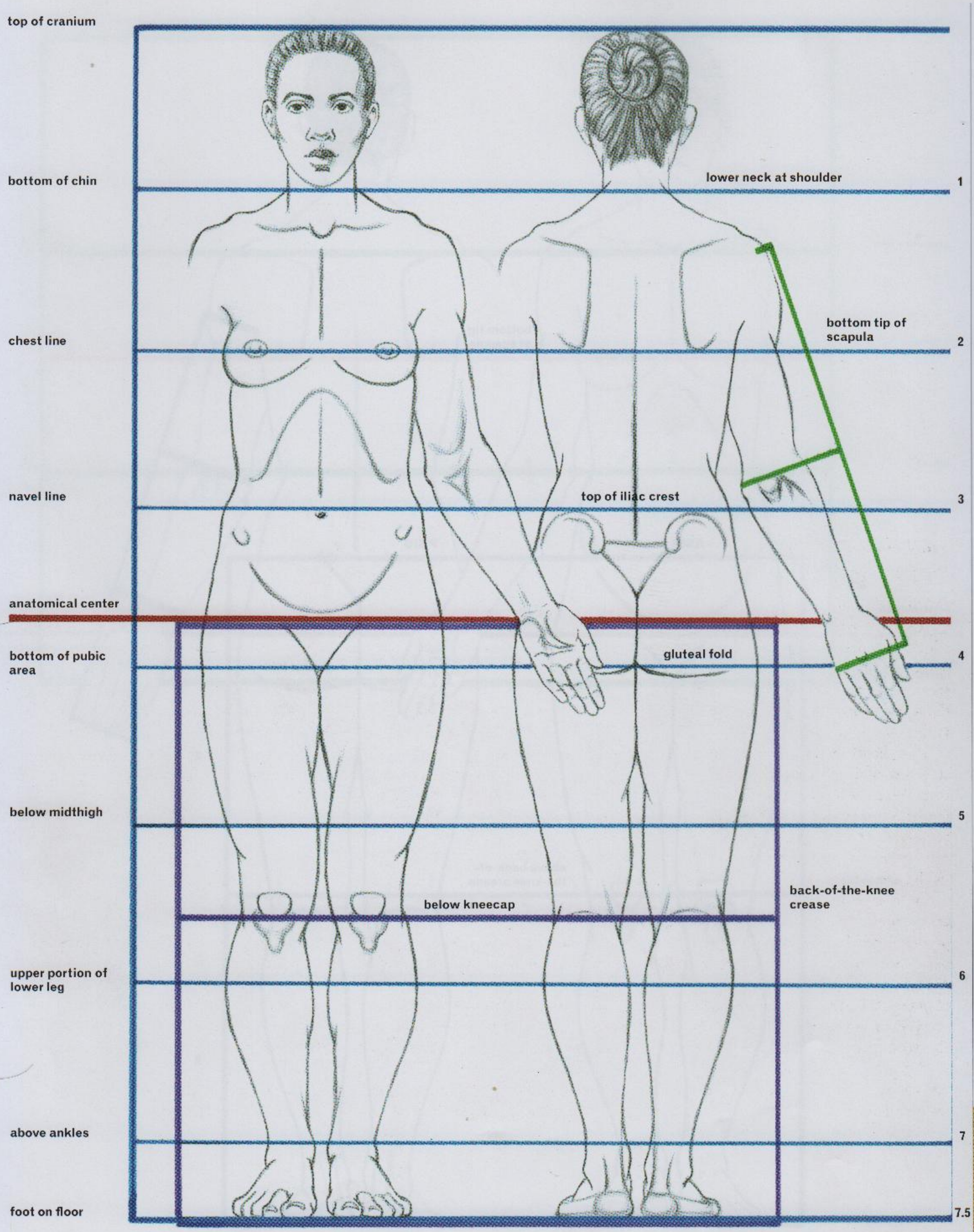
In this system, the torso is the easiest region to mark off because the proportional alignments generally fall on surface landmarks. From the torso down, however, the head-length unit of measurement doesn't quite land on specific forms, although it comes very close near the ankles.

The proportional breakdowns for the seven-and-a-half-head system are as follows:

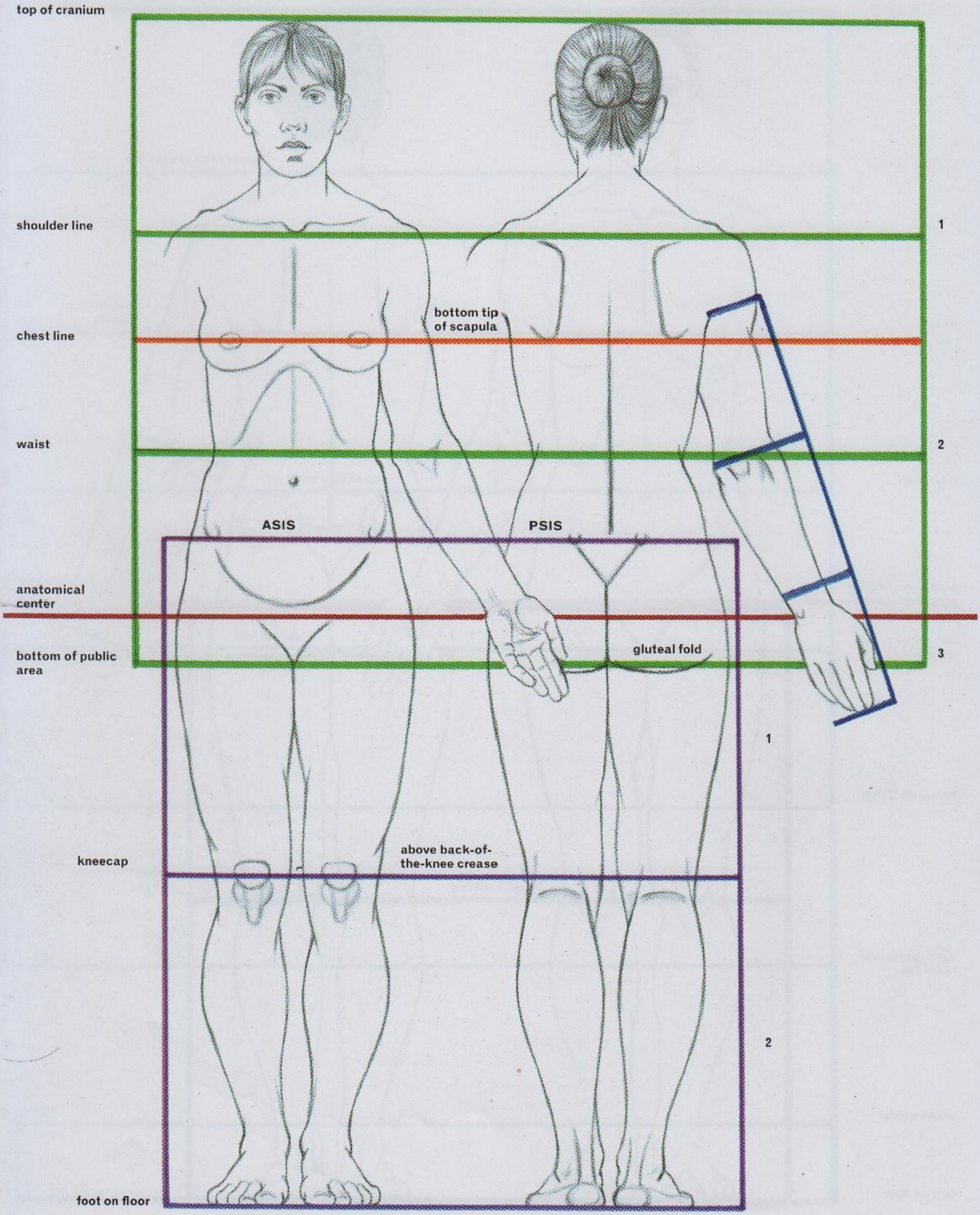
1. For the front view: from the top of the cranium to the bottom of the chin. For the back view: from the top of the cranium to the lower neck, near the shoulders.
2. For the front view: from the bottom of the chin to the chest line (nipple line). For the back view: from the lower neck (near the shoulders) to the bottom tips of the scapula bones.
3. For the front view: from the chest line to the navel. For the back view: from the bottom tips of the scapula bones to the top of (or slightly above) the iliac crest of the pelvis.
4. For the front view: from the navel to the bottom of the pubic area. For the back view: from the top of the iliac crest to the horizontal gluteal fold.
5. For the front view: from the bottom of the pubic area to the lower midthigh (approximate). For the back view: from the horizontal gluteal fold to the lower midthigh (approximate).
6. For both front and back views: from the lower midthigh to the upper portion of the lower leg (approximate).
7. For both front and back views: from the upper portion of the lower leg to just above the ankles.

7.5. For both front and back views: from above the ankles to the sole of the foot placed flat on the floor.

It can be helpful to divide the legs in half when determining their length using this system of measurement. The breakdowns are as follows. For the front view: Divide in half the area from the pubic bone (the anatomical center) to the sole of the foot placed flat on the floor. The halfway line will fall at the bottom of the kneecap (patella). For the back view: Divide in half the area from the midpoint of the vertical gluteal cleft (between the base of the sacral triangle and the horizontal gluteal fold) to the sole of the foot placed flat on the floor. The halfway line will fall on the back-of-the-knee crease.



PROPORTIONAL SYSTEM USING SEVEN AND A HALF HEADS



PROPORTIONAL SYSTEM OF DIVISIONS

The Proportional System of Divisions

This system divides the figure into thirds and halves. Instead of using the head as the unit of measurement, you simply divide the torso into three sections and the lower limb into two sections, with an additional division (front and back) for the placement of the chest line and scapula bones. This system works well when you are quickly blocking in the figure, since the ribcage region is one unit, the pelvis region is another unit, and the head, neck, and shoulders together are a third unit. The legs and arms can be added once the head and torso have been established.

The breakdowns for the head and torso using the proportional system of divisions are as follows:

1. For the front view: from the top of the cranium to the shoulder line (through the clavicles and the pit of the neck). For the back view: from the top of the cranium to the shoulder line (a line drawn from the end of one shoulder all the way through the end of the other shoulder).
2. For both front and back views: from the shoulder line to waist. (To locate the chest line or scapula line, divide the space between the shoulder line and waist in half.)
3. For the front view: from the waist to the bottom of the pubic area. For the back view: from the waist to the horizontal gluteal fold.

It can also be helpful to divide the legs in half when determining their length using this system of measurement. The breakdowns are as follows. For the front view: Divide in half the area from slightly below the ASIS of the pelvis to the sole of the foot placed flat on the floor. The halfway line will fall in the middle of the kneecap (patella). For the back view: Divide in half the area from the PSIS of the pelvis (the dimples on sacral triangle) to the sole of the foot placed flat on the floor. The halfway line will be above the back-of-the-knee crease.

ACTION LEANING POSE

Proportional Breakdowns of the Arms and Legs

There are a number of variations on how to break down the proportions of the arms and legs. Most of these methods can work with any proportional canon.

PROPORTIONAL BREAKDOWN OF ARMS

When the arms are relaxed and at the sides of the torso, the elbows (olecranons) generally align with the waist. The wrists usually align with the anatomical center of the figure (the position of the pubic bone and the greater trochanter of the femur), although the wrists sometimes fall a little lower. There are two methods for breaking the arm down proportionally:

1. In this method, divide in half the area from the top of the shoulder to the MCP joint of the middle finger. The halfway line will be directly above the elbow (olecranon).
2. In this second method, the length of the arm is approximately equal to three head lengths. Using the length of the head as the unit of measurement, the first third of the arm extends from the armpit (axilla) to just above the elbow; the second third extends from just above the elbow (olecranon) to just above the wrist; and the last third extends from above the wrist to the tip of the middle finger. (This three-part division does not include the mass of the shoulder from the armpit to the top of the shoulder.)

PROPORTIONAL BREAKDOWN OF LEGS

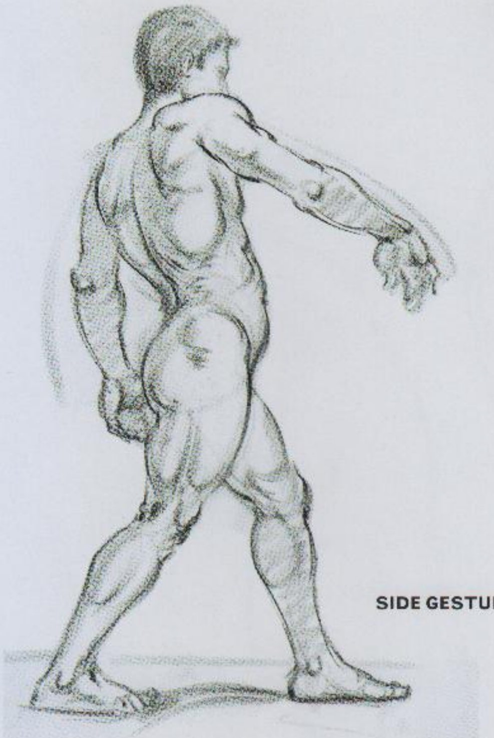
There are three basic ways to determine the placement of the knee once the height of the overall figure has been established. Generally, the upper leg is about the same length as the lower leg. If, in your drawing, the upper leg (thigh) looks too long, raise the kneecap slightly; if the thigh looks too short compared with the lower leg, move the kneecap slightly lower. Here are the three methods:

1. For the front view: Divide the straight leg in half from slightly below the ASIS on the pelvis to the sole of the foot placed flat on the floor. The halfway line approximately marks the center of the kneecap (patella). For the back view: Divide the straight leg in half from the PSIS (the dimples on the top border of the sacral triangle of the pelvis) to the sole of the foot placed flat on the floor. The halfway line will divide the leg slightly above the back-of-the-knee crease.
2. For the front view: Divide the straight leg in half from the pubic bone of the pelvis (where the inguinal ligament inserts) to the sole of the foot placed flat on the floor. The halfway line will be directly below the patella (kneecap). For the back view: Divide the straight leg in half from the midpoint of the vertical gluteal cleft to the sole of the foot placed flat on the floor. The halfway line will mark the position of the back-of-the-knee crease.
3. The third method, unlike the others, can only be used with the eight-head proportional system. For the front view: Divide the straight leg in half from the pubic bone to the sole of the foot placed flat on the floor. The halfway line will mark the placement of the tibial tuberosity (the bump on the tibia bone, which is below the patella and the fatty pad of the knee). For the back view: Divide the straight leg in half from below the midpoint of the vertical gluteal cleft to the sole of the foot placed flat on the floor. The halfway line will fall just below the back-of-the-knee crease.

PROPORTIONAL BREAKDOWN OF HANDS AND FEET

The length of the hand (with fingers extended), measured from the tip of the middle finger to the wrist, is approximately the same as the length of the face from the bottom of the chin to the hairline.

The length of the foot, measured from the tip of the great toe to the back of the heel, approximately equals the length



SIDE GESTURE

of the whole head from the top of the cranium to the bottom of the chin.

For additional proportional breakdowns of the head, hand, and foot, refer to the appropriate chapters.

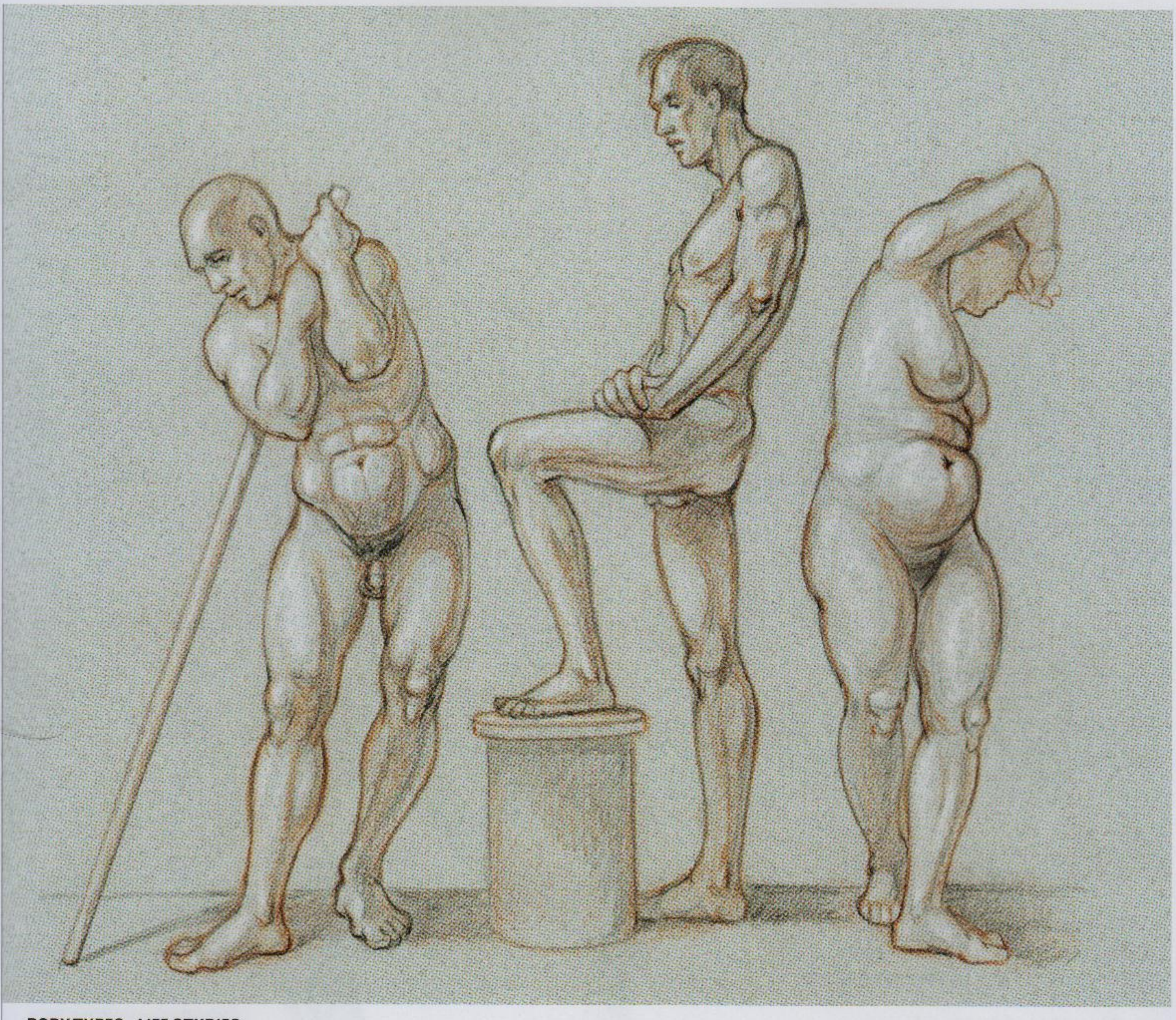
Widths of Body Parts

A few general remarks on the widths of parts of the body (and on how gender differences tend to affect body parts' widths) may be useful:

The widths of the joints become narrower as one progresses down the limb from the most proximal attachment to the most distal attachment. The arm is wider where it attaches into the torso than at the elbow joint, and the wrist joint, in turn, is narrower than the elbow joint. The same applies to the leg: The leg is widest where the thigh connects to the hip, narrower at the knee joint, and narrower still at the ankle joint. Of course, these widths do vary, depending on the muscles attaching near these joints and on the particular perspective from which the limb is being observed.

Men's hips tend to be narrower, and women's wider. The reverse is true of the shoulders, which tend to be broader on the male figure and narrower on the female.

ARCH POSE



BODY TYPES—LIFE STUDIES

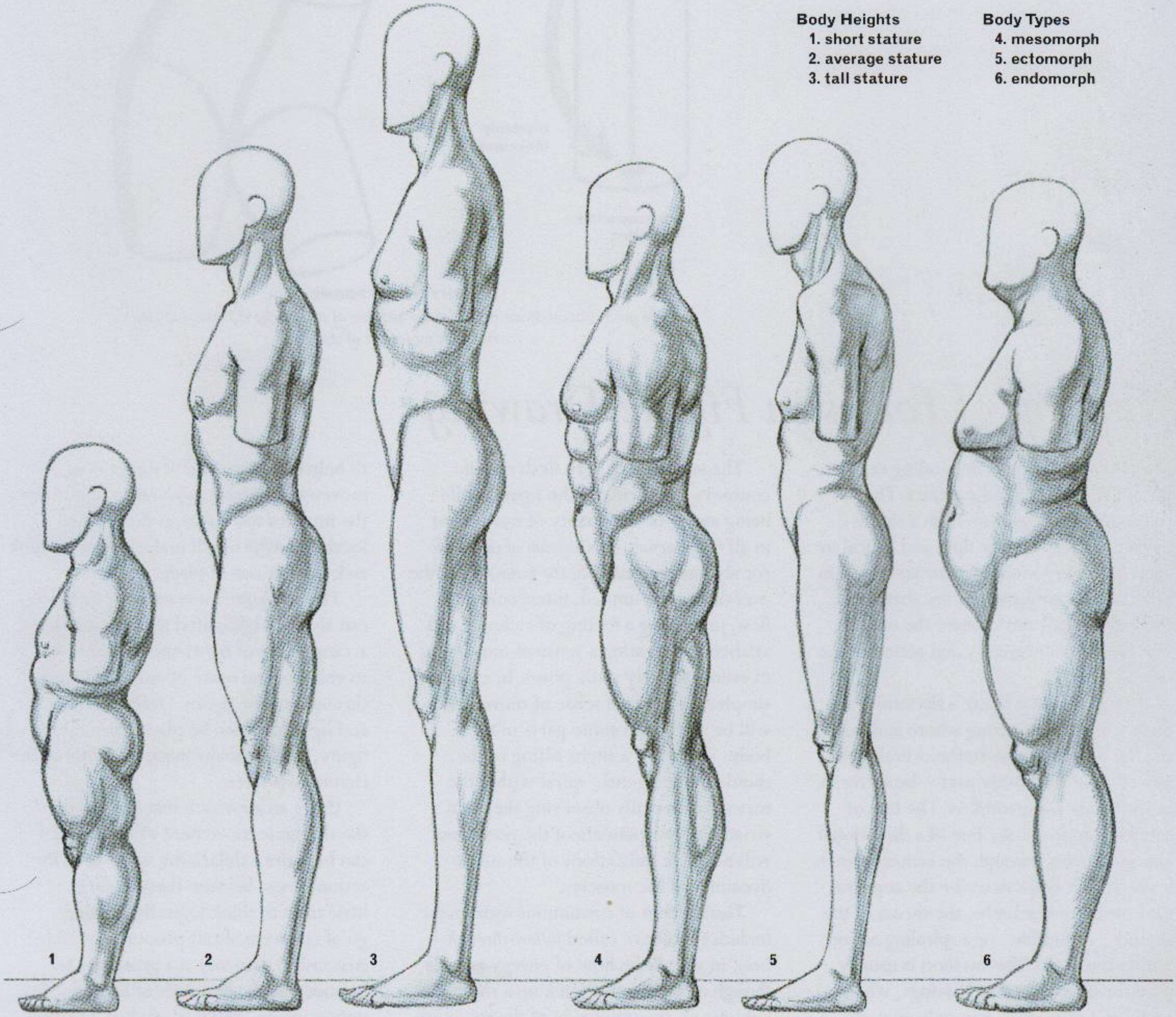
Body Heights and Body Types

It is essential to keep in mind that the canons presented above do *not* work for every human figure. After all, the height of an adult human being can range from less than three feet to nearly eight feet, but the size of the cranium is usually about the same from one adult to another no matter how tall a person is. For this reason, eight-head and seven-and-a-half-head systems simply will not work for people of exceptionally short or exceptionally tall stature. For such figures, it is necessary to develop different measuring systems—systems that may use their head sizes in relation to their own unique body heights.

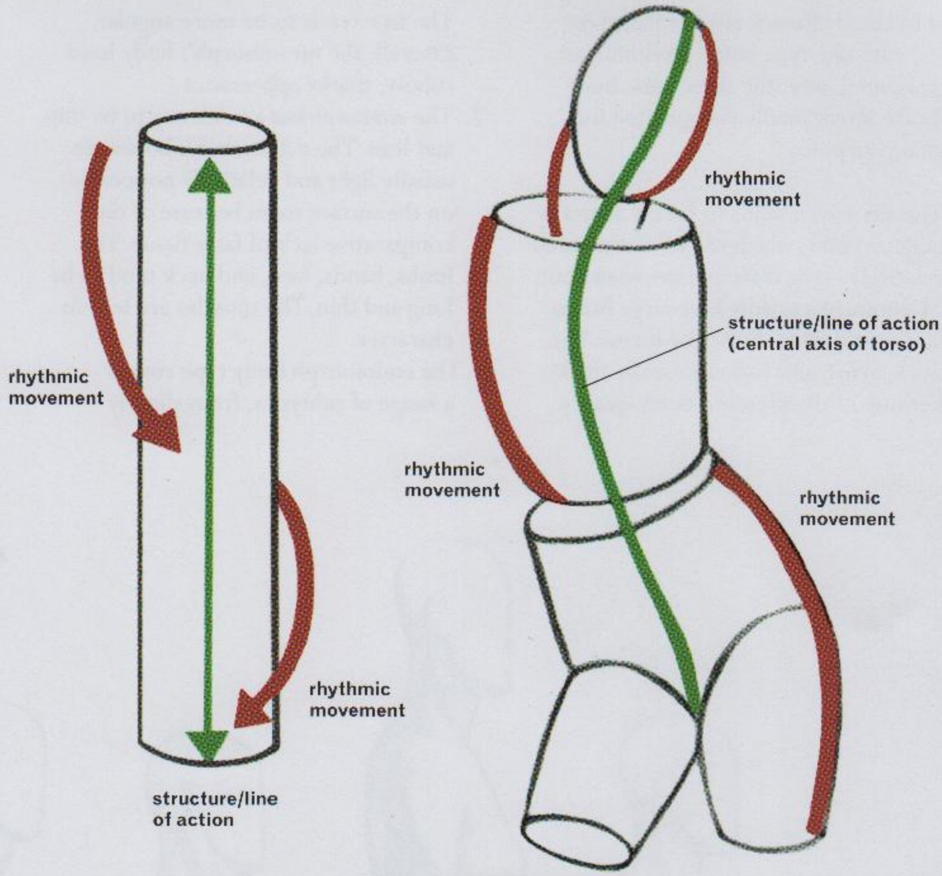
Besides height, you must also take into account the tremendous variation in body shapes among human beings. This book, like other anatomy books, focuses primarily on trim figures with significant muscular definition. Focusing on this sort of figure is a learning mechanism. Once the basic anatomical information has been grasped, it becomes essential to study *all* types of bodies.

Researchers have determined that there are three basic body types, each with its own particular characteristics. Note, however, that this view can lead to stereotyping; in reality, people's bodies tend to blend characteristics of all three types, with one type being predominant. As presented here, the three basic body types are intentionally exaggerated for learning purposes:

1. The *mesomorph* tends to have a naturally athletic build, which can be accentuated relatively easily if the person works out. Mesomorphs usually have large bones and well-defined muscular forms. The neck, arms, and legs are usually thick because of the muscles' beefy quality. The face tends to be more angular. Overall, the mesomorph's body has a robust, stocky appearance.
2. The *ectomorph* has a tendency to be thin and lean. The ectomorph's bones are usually light and relatively noticeable on the surface form because of the comparative lack of fatty tissue. The limbs, hands, face, and neck tend to be long and thin. The muscles are lean in character.
3. The endomorph body type covers a range of subtypes, from slightly plump and fleshy, to portly and stout, to extremely heavy and obese. This endomorph's body has more fatty tissue, which softens out most of the muscle definition. The forms of the upper leg are more massive than those the lower leg, and the same applies to the upper and lower arm. The joints of the ankles and wrist appear slender because there is very little fatty tissue at these joints. The belly forms are soft and bulbous. The face tends to be round and full.



BODY HEIGHTS AND BODY TYPES (ADULT MALES)



RHYTHM OF FORMS

The green lines indicate the structure and line of action; the red lines indicate the rhythmic movement of the forms.

Rhythm of Forms in Figure Drawing

Muscles change shape depending on the pose: They stretch and contract. They twist and bend. And, even on a single figure, they can appear fluid and lyrical in some areas and more angular and tense in others. Concentrating on the rhythm of muscular forms can capture the unique, vibrant, dynamic energy and action of the overall figure.

To perceive the figure's rhythmic quality, begin by sensing where and how the *line of action* flows in the overall pose as well as in each body part—head, torso, arms, hands, legs, and feet. The line of action is an imaginary line of a directional energy moving through the center of each body part. It helps describe the angle or tilt of the head or limbs, the thrust of the shoulder or hip line, or a spiraling action within the torso. This method is usually used for quick gesture drawings, when each brief pose gives you only enough time to capture the "essence" of the pose and you cannot get bogged down in all the details. (The line of action is equivalent to the central axis, described in chapter 1.)

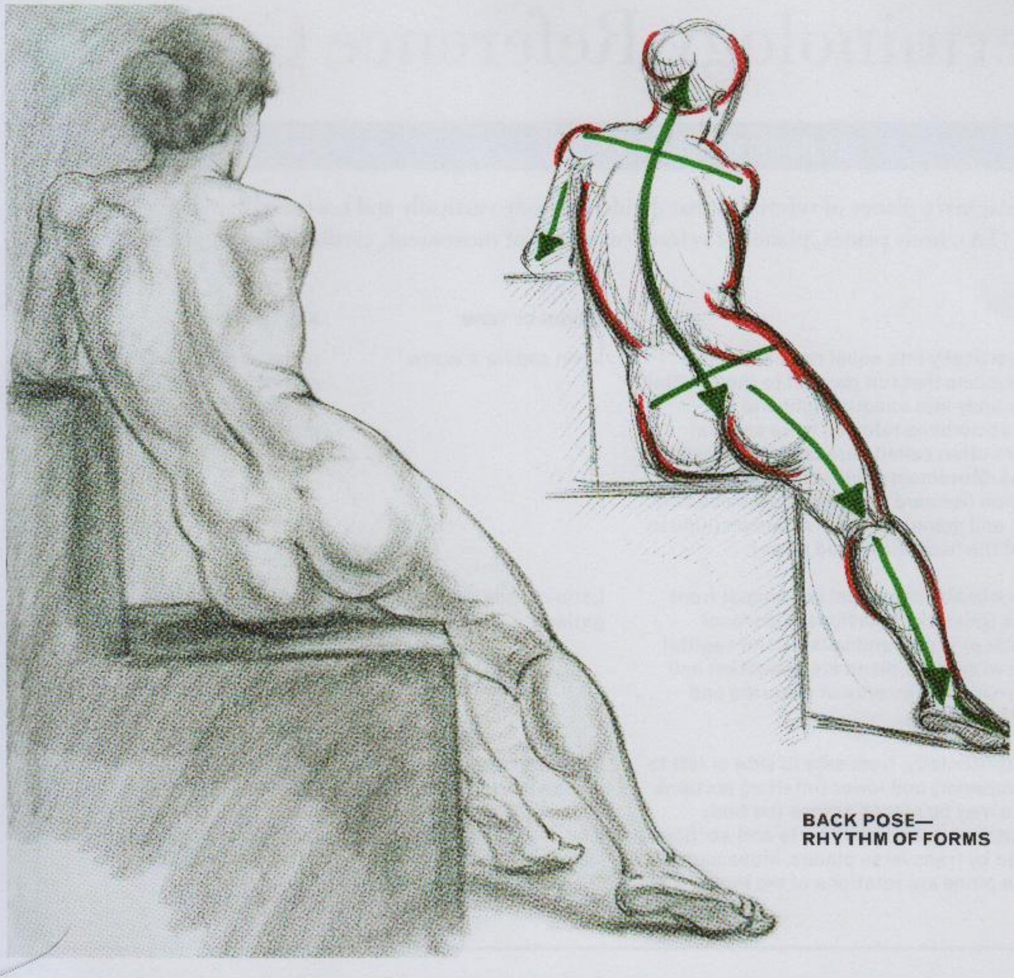
The second step is to flesh out the contours and forms of the figure while being aware of the quality of movement in all these areas. This *rhythm of the forms* (or *rhythmic movement of the forms*) gives the overall figure a unified, interconnecting flow, producing a feeling of richness and vitality and creating a sense of movement in even relatively static poses. In even the simplest of poses, a sense of movement will be evident in some parts of the body—whether a slight tilting of the shoulders or a gentle spiral within the torso. By carefully observing the main structural components of the pose, you will perceive indications of the subtle dynamics of the muscles.

This rhythm of continuous movement includes what are called *follow-through lines,* in which the flow of energy crosses though a body part to pick up a rhythmic contour on the other side of the structure. Follow-through lines can be applied in subtle or exaggerated ways to give an image a more dynamic quality. You may slightly exaggerate the shapes of muscles to help create a sense of directional movement so long as you do not position the muscles too far from their actual locations, which will make the forms look awkward or out of place.

The rhythmic movement of the forms can also be highlighted through a lyrical arrangement of lights and darker tones to enhance the sense of energy moving throughout the figure. Darker tones and lights can also be placed around the figure, in the background, to continue the rhythmic pattern.

Using an approach that focuses on the rhythmic movement of the forms can be quite exhilarating when drawing action poses, because there is very little time to think logically. Letting go of concerns about proportions and anatomical accuracy is a great way to balance out the demands of longer, tighter, more analytical studies. The best approach is to let your intuition flow through the drawing.

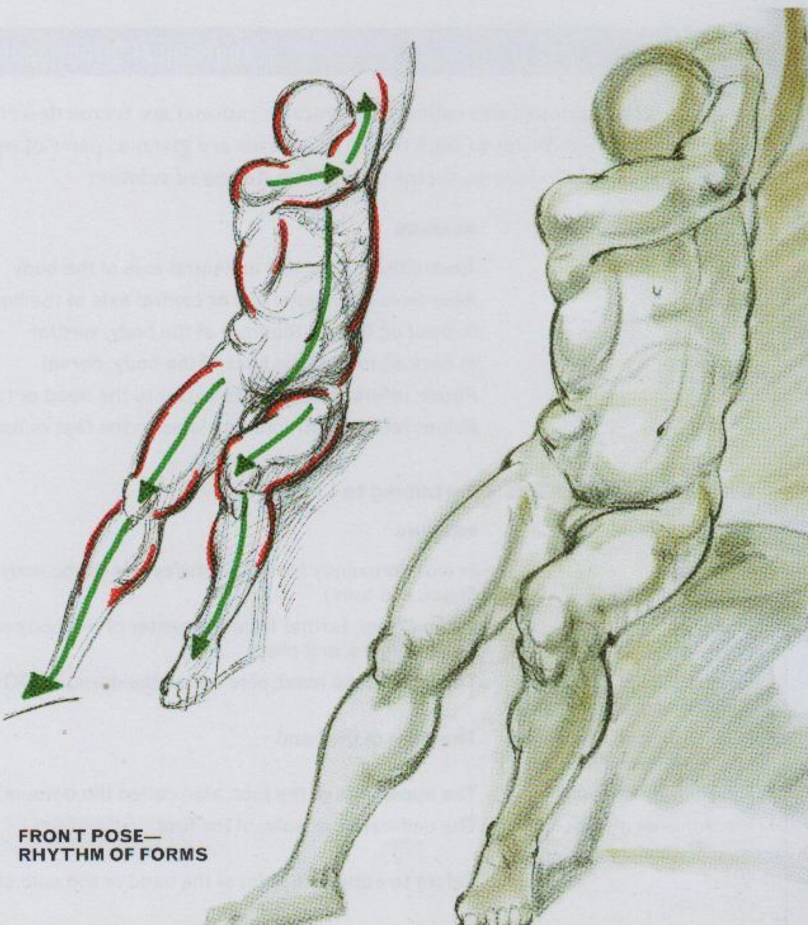
But even drawings of longer, quieter, more subdued poses can benefit from the



BACK POSE—
RHYTHM OF FORMS

application of the principles of rhythmic movement. If the muscular forms start to look too stiff or lifeless, then begin searching for any interesting dynamics within the pose—a pattern of angles, a rich contour in one location being echoed in another, or areas in which stretching or compression is occurring. These dynamics establish connections between forms, creating a sense of graceful unity or one of dramatic tension.

Master artists from many cultures throughout history have integrated the idea of rhythmic movement into their work. Studying figurative sculptures, drawings, and paintings by past and contemporary masters not only gives you valuable insight into their interpretations of the human figure, but it can also inspire you to try similar techniques, methods, and approaches. By drawing from the human figure using a variety of methods and systems, you will gain a deep reservoir of skills that, over time, will help you develop a technique and style that is all your own.



FRONT POSE—
RHYTHM OF FORMS

Anatomical Terminology Reference Guide

Anatomical Planes

The anatomical planes are three fixed, imaginary planes of reference that divide the body vertically and horizontally while it is in the anatomical position. *Synonyms:* plana (TA), body planes, planes of reference, planes of movement, cardinal planes, planes of section, principal planes

PLANE	DESCRIPTION	ORIGIN OF TERM	SYNONYMS
Sagittal Plane (SAAJ-ih-tul)	Divides the body vertically into equal right and left halves. Vertical divisions that run parallel to the sagittal plane, dividing the body into unequal right and left portions, are also sometimes referred to as sagittal planes but are more often called parasagittal planes or paramedian planes. Movements within this plane are flexion and extension (forward and backward movement of the limbs, head, and spine) and lateral flexion (side to side movements of the head, neck, and torso).	Latin *sagitta* = arrow	plana sagittalia (TA), plana medianum (TA), median plane, midsagittal plane, median-sagittal plane
Coronal Plane (KOR-uh-nul)	Divides the body vertically into equal or unequal front (anterior) and back (posterior) portions. A coronal plane (or frontal plane) is perpendicular to the sagittal plane. Movements within this plane are abduction and adduction (side-to-side movements of the arms and legs) and lateral flexion.	Latin *corona* = crown, garland	plana frontalia (TA), plana coronalia (TA), frontal plane, anterior plane
Transverse Plane	Divides the body horizontally, from side to side or left to right, into upper (superior) and lower (inferior) portions. A transverse plane may be placed across the body anywhere; individual bones and body parts and sections may also be divided by transverse planes. Movements within a transverse plane are rotations of the limbs, head, and spine.	Latin *transversus* = crosswise, turned across	plana transversalia (TA), horizontal plane, axial plane, transaxial plane, cross-sectional plane, cross, cross section

Anatomical Directions/Locations

Anatomical directions (also called anatomical locations) are terms describing the location of various body structures (bone, muscles, etc.) in relation to each other. The terms are given as pairs of opposites. *Synonyms:* directional terms, terms of direction, terms of location, locations, terms of position, terms of relation

TERM	MEANING
Medial	*Toward* the medial line or central axis of the body
Lateral	*Away from* the medial line or central axis of the body
Anterior	*In front of*; toward the front of the body; ventral
Posterior	*In back of*; toward the back of the body; dorsal
Superior	*Above*; refers to structures closer to the head or toward the upper part of the body or of a structure or body part
Inferior	*Below*; refers to structures closer to the feet or toward the lower part of the body or of a structure or body part

Direction/Location Terms Pertaining to Limbs

TERM	MEANING
Proximal (PROK-sih-mull)	*In close proximity to*; nearer the center of the body or the point of origin on the torso (can pertain to limbs, finger, and toes)
Distal (DISS-tull)	*Distant from*; farther from the center of the body or from the point of origin of a limb on the torso (can pertain to limbs, fingers, and toes)
Dorsal Side of Hand (DOOR-sull)	The back of the hand; also called the dorsum (DOOR-sum)
Palmar Side of Hand (PAHL-mar *or* PAWL-mer)	The palm of the hand
Dorsal Side of Foot	The upper side of the foot; also called the dorsum (DOOR-sum)
Plantar Side of Foot (PLAN-tar)	The underside, or sole, of the foot
Volar (VOH-lar)	Refers to either the palm of the hand or the sole of the foot

Movement within the Sagittal Plane

Movements within the sagittal plane are the angular movements of flexion, extension, and hyperextension.

MOVEMENT	MEANING	ORIGIN OF TERM
Flexion	The action of *bending,* which decreases the angle between two bones or two parts of the body.	Latin *flectere* = to bend
Extension	The action of *straightening,* which increases the angle between two bones or two parts of the body. The opposite of flexion, extension returns the joint or body part to the anatomical position.	Latin *extendere* = to stretch out
Hyperextension	Extension of a limb or body part *beyond the anatomical position* (or normal limit).	Greek *hyper* = above, over + Latin *extendere* = to stretch out

Thumb Movement within the Sagittal Plane

The movement of the thumb in forward and backward motion on the sagittal plane is not considered flexion/extension but rather abduction/adduction because of the thumb's sideways position on the hand.

Movement within the Coronal Plane

Movements within the coronal, or frontal, plane are the angular movements of abduction and adduction and of lateral flexion.

MOVEMENT	MEANING	ORIGIN OF TERM
Abduction	Movement *away from a medial line* (either the midline of the body or that of a body part).	Latin *abducere* = to take away
Adduction	Movement *toward a medial line* (either the midline of the body or that of a body part).	Latin *addere* = to bring forward
Lateral Flexion	*Side bending* of the vertebral column (trunk and/or head).	Latin *lateralis* of the side + *flectere* = to bend

Movement within Transverse Planes

Movements within transverse planes are rotational movements: lateral rotation and medial rotation, as well as the specialized rotational movements of the forearm known as supination and pronation.

MOVEMENT	MEANING	ORIGIN OF TERM
Lateral Rotation	Rotation *away from* the medial line of the body.	Latin *lateralis* side + *rotare* = to revolve
Medial Rotation	Rotation *toward* the medial line of the body.	Latin *medialis* = of the middle + *rotare* = to revolve
Supination (SOO-pih-NAY-shun)	Rotational movement of the forearm in which the palm is facing forward or upward; in this position, the radius and ulna bones of the lower arm are parallel.	Latin *supinus* = lying on the back
Pronation (pro-NAY-shun)	Rotational movement of the forearm in which the palm is facing backward or downward; in this position, the radius crosses over the ulna to form an X.	Latin *pronare* = to bend forward

Movement within All Three Planes

The movement known as circumduction, which involves the whole arm or whole leg, occurs across all three planes. Circumduction should not be confused with rotation, which generally occurs on the transverse plane.

MOVEMENT	MEANING	ORIGIN OF TERM
Circumduction (sir-kum-DUCK-shun)	Circular movement of an arm, leg, hand, foot, or finger that draws an imaginary circle in space.	Latin *circum* = around + *docere* = to lead, to draw

Special Anatomical Movements

Special anatomical movements occur at specific joints and, according to some experts, do not readily fit into the other movement categories.

Movements of the Foot

MOVEMENT	MEANING	ORIGIN OF TERM
Inversion	Movement of the foot in which the sole turns *inward,* or medially (toward the medial line of the body)	Latin *invertere* = to turn about, to turn over
Eversion (ee-VER-zhun)	Movement of the foot in which the sole turns *outward,* or laterally (away from the medial line of the body)	Latin *evertere* = to turn out, to twist about
Plantar Flexion (PLAN-tar FLEK-shun)	Movement of the foot from the ankle joint in which the foot and toes point *downward*	Latin *planta* = sole of the foot + *flectere* = to bend
Dorsiflexion (door-sih-FLEK-shun)	Movement of the foot from the ankle joint in which the top (dorsum) of the foot is lifted with the toes pointing *upward*	Latin *dorsum* = back + *flectere* = to bend

Movements of the Thumb

MOVEMENT	MEANING	ORIGIN OF TERM
Opposition	Movement of the thumb in which the pad of the thumb touches the tip of another finger	Latin *opponere* = to oppose
Reposition	Movement of the thumb from opposition back to the anatomical position	Latin *re* = back + *ponere* = to place

Elevation and Depression

MOVEMENT	MEANING	ORIGIN OF TERM
Elevation	Movement of a body part *upward* (in a superior direction)	Latin *elevare* = to raise, to lift
Depression	Movement of a body part *downward* (in an inferior direction)	Latin *deprimire* = to press down

Protraction and Retraction

MOVEMENT	MEANING	ORIGIN OF TERM
Protraction	Movement of a body part *forward* (in an anterior direction); also called *protrusion*	Latin *pro* = forward + *trachere* = to draw
Retraction	Movement of a body part *backward* (in a posterior direction); also called *retrusion*	Latin *re* = back + *trachere* = to draw

Connective Tissues

Connective tissues bind and connect structures and protect and support them. The wide variety of connective tissues includes cartilage, ligaments, tendons, and fatty tissue, among others. Each type of connective tissue is specialized to perform certain functions.

Cartilage

Origin of term: Latin *cartilago* = gristle
Cartilage functions as a precursor to bone, offers protection to joints, and acts as a shock absorber and structural strengthener. The three types of cartilage exhibit differences in hardness and elasticity/resilience.

TYPE OF CARTILAGE	EXAMPLES	ORIGIN OF TERM	SYNONYMS
Hyaline Cartilage (HI-ah-lin KAR-tih-lij)	costal cartilage, thoracic arch (ribcage arch), parts of larynx (voice box), trachea (windpipe), alar and lateral cartilage of nose, articular cartilage of joints	Greek *hyalos* = glass	—
Fibrocartilage (fi-bro KAR-tih-lij)	intervertebral discs of vertebral column, pubic symphysis of pelvis, menisci fibrocartilage pads of knee joint	Latin *fibra* = fiber	fibrocartilago, white fibrocartilage
Elastic Cartilage	external ear	Greek *elunein* = to drive, to set in motion	yellow cartilage, yellow fibrocartilage

Ligaments

Origin of term: *ligamentum* = band, bandage
Ligaments are bands or sheets of nonelastic fibrous connective tissue that act as tough straps surrounding joints and binding bones to other bones (or to other structures). They stabilize and strengthen joints and help determine range of movement.

TYPE OF LIGAMENT	DESCRIPTION	ORIGIN OF TERM	SYNONYMS
Ligaments on Synovial Joints	Most synovial joints are enclosed with a fibrous joint capsule held together by ligaments, which reinforce the external surface of the capsule and strengthen the joint.	—	—
Inguinal Ligament (ING-gwih-nul LIG-uh-ment)	The inguinal ligament is a fibrous band formed by the thicker lower border of the aponeurosis of the external oblique muscle.	Latin *inguen* = groin	arcus inguinalis (TA), ligamentum inguinale (TA), Poupart's ligament
Nuchal Ligament (NEW-kull)	The nuchal ligament is a flat, triangular, sail-like ligament that attaches to the base of the skull and then attaches along the spinous processes of the cervical vertebrae	Latin *nucha* = nape of neck	ligamentum nuchae (TA), posterior cervical ligament

Tendons

Origin of term: Latin *tendere* = to stretch, to extend. Synonyms: tendo (TA), sinew
Tendons are nonelastic fibrous cords or bands that anchor or attach muscles to bones (or to other structures).

Aponeurosis

(AP-oh-new-ROH-siss)
Origin of term: Greek *apo* = from + *neuron* = sinew
Aponeurosis is a flat, broad, fibrous sheathing or expanded tendon that attaches muscles to bones or, in some cases, to other structures.

Fascia

(FASH-ee-uh *or* FAY-shee-uh)
Origin of term: Latin *fascia* = band, bandage
Fascia is connective tissue forming sheaths to connect muscles individually and hold them together in groups. There are two types of fascia.

TYPE OF FASCIA	DESCRIPTION	SYNONYMS
Superficial Fascia	Forms the layer of fibroelastic tissue underneath the skin that contains mostly fatty tissue (also known as subcutaneous fat)	hypodermis (TA), tela-subcutanea (TA), subcutaneous tissue, subcutaneous fascia, fibroelastic tissue, fascia superficialis
Deep Fascia	Thin, fibrous membrane, devoid of fat, that wraps around individual muscles and groups of muscles, binding them together (much like a body stocking) and helping hold them in position	fascia (TA), fasciae musculorum (TA), fascia of muscles, muscular fascia

Subcutaneous Fat

(SUB-kyoo-TAY-nee-us)
Origin of term: Latin *sub* = below + *cutanea* = the skin. Synonyms: panniculus adiposus (TA), fatty layer, fatty tissue, adipose tissue, subcutaneous tissue, subcutaneous layer
Subcutaneous fat helps support structures, offers padding for protection, and provides insulation and storage for fuel reserves.

Classification of Bones by Shape

The shapes of bones can reveal their function. There are four different classes of bones, distinguished by their general shape.

TYPE OF BONE	DESCRIPTION	EXAMPLES	SYNONYMS
Long Bone	Long bones consist of an elongated, cylindrical shaft (diaphysis) and two expanded ends (epiphysis). Found in the limbs, long bones vary in size. They are slightly curved, and their forms tend to spiral. The enlarged ends help stabilize joints and serve as attachments sites for ligaments and tendons. Long bones also serve as levers, making movement possible.	femur, tibia, fibula, humerus, ulna, radius, clavicle, metacarpals, metatarsals	os longum (TA)
Short Bone	Short bones are about equal in length and width and tend to be roughly cube-shaped (cuboid). They act as shock absorbers.	tarsal bones, carpal bones, sesamoid bones	os breve (TA)
Flat Bone	Flat bones are thin and somewhat curved. They provide a surface for attachment of muscles and function to protect underlying soft tissues.	sternum, cranial bones, ilium (of pelvis), scapula bones, ribs	os planum (TA)
Irregular Bone	Irregular bones have complex, intricate shapes.	vertebrae, facial bones	os irregulare (TA), mixed bones

Surface Features of Bones

Synonyms: surface markings on bones, bone markings, bone features, surfaces of bones, bone landmarks

Projections for Tendon and Ligament Attachments

FEATURE	MEANING	ORIGIN OF TERM	SYNONYMS
Crest	A narrow, prominent ridge	Latin *crista* = comb or tuft on the head of a bird	crista (TA), ridge
Epicondyle (ep-ih-KON-dial)	A small, non-articular projection above a condyle	Greek *epi* = at, on, upon + *kondylos* = knuckle	epicondylus (TA)
Process	A general term for any bony prominence	Latin *processus* = progress, process, an advance, a going forward	processus (TA)
Protuberance	A protruding projection	Latin *protuberare* = to swell	protuberantia (TA)
Spine	A sharp, slender, pointed process	Latin *spina* = thorn	—
Trochanter (troh-KAN-ter)	A very large, rough projection found only on the femur bone	Greek *trochanter* = runner	—
Tubercle (TOO-burr-kul)	A small, rounded projection	Latin *tuberculum* = a swelling or knob	tuberculum (TA)
Tuberosity (TOO-burr-OSS-ih-tee)	A large, rounded projection that is sometimes rough in texture	Latin *turberosus* = full of bumps	tuberositas (TA)

Articulating Surfaces (Features That Help Form Joints)

FEATURE	MEANING	ORIGIN OF TERM	SYNONYMS
Condyle (KON-dial)	A rounded articular projection at the extremity of a bone; usually occurs in pairs	Greek *kondylos* = knuckle	condylus (TA)
Facet	A small, shallow (nearly flat) articulating surface	French *facette* = little face	—
Head	A large, usually ball-shaped expansion at the end of a bone	—	—
Trochlea	A spool-like articulating surface that acts like a pulley	Greek *trochileia* = pulley	—

Depressions (for Muscles) and Openings (for Blood Vessels and Nerves)

FEATURE	MEANING	ORIGIN OF TERM	SYNONYMS
Foramen (foh-RAY-men)	A round or oval aperture (opening)	Latin *forare* = to pierce	—
Fossa (FOSS-uh)	A shallow, basin-like depression	Latin *fossa* = ditch, trench	—

Bones of the Cranium

Eight bones, including two sets of paired bones, make up the cranial portion of the skull, forming the bony encasement that houses and protects the brain.

BONE	DESCRIPTION/CHARACTERISTICS	ORIGIN OF TERM	SYNONYMS
Frontal Bone *one bone* (FRUN-tul)	Forms the forehead, the superciliary arches (brow ridge), most of the roof within the orbital cavity (eye socket); includes a depression between the superciliary arches, called the nasion (root of nose), as well as a triangular, keystone-shaped bony wedge between the brow-ridge arches, called the glabella; forms transitional plane changes, called the superior temporal lines (temple lines), between the front plane of the forehead and the side planes of the cranium	Latin *frons* or *frontis* = forehead, brow	os frontal (TA), forehead
Parietal Bones *paired bones* (puh-RYE-eh-tul)	Form the greater portion of the lateral (outside) walls of the cranium; form most of the roof of the cranium	Middle Latin *parietalis* = of a wall	os parietale (TA)
Occipital Bone *one bone* ock-SIP-ih-tul	Forms the posterior aspect of the cranium; forms the posterior part of the cranium floor (base); includes the external occipital protuberance (bony bump on lower portion of back of cranium), which serves as an attachment site for muscles that move the head; includes the external occipital crest (underneath the skull), which serves as an attachment site for the nuchal ligament; includes the occipital condyles (underneath the skull, on either side of the foramen magnum—the opening for the spinal cord), which articulate with the first cervical (neck) vertebra to move the head in a rocking forward-and-back motion	Latin *occiput* = back part of head	os occipitale (TA)
Temporal Bones *paired bones* (TEM-poor-al)	Form the lower portion of the lateral walls of the cranium; form part of the cranium floor (base); contain the external auditory meatus (ear canal); include the mastoid process (large bony projection), which serves as an attachment site for certain neck muscles; include the zygomatic process (of the temporal bone), a thin bridge of bone that connects to the zygomatic bone of the maxilla to form the zygomatic arch	Latin *temporalis* = belonging to the temples	os temporale (TA), temple bones
Sphenoid Bone *one bone* SFEE-noyd	Butterfly-shaped bone; forms the central part of the cranium floor (base); forms a small portion of the lateral wall of the cranium; forms a posterior part of the orbital cavities (eye sockets)	Greek *sphenoeides* = resembling a wedge	os sphenoidale (TA), sphenoidal bone
Ethmoid Bone *one bone* ETH-moyd	Forms part of the nasal septum; forms roof and lateral walls of nasal cavity; forms part of the inside wall of the orbital cavities (eye sockets); forms the front part of the cranium floor (base)	Greek *ethmos* = sieve	os ethmoidale (TA), ethmoidal bone

Bones of the Face

Fourteen bones, including six sets of paired bones, create the bony framework for the muscles of the face.

BONE	DESCRIPTION/CHARACTERISTICS	ORIGIN OF TERM	SYNONYMS
Zygomatic Bones *paired bones* (zigh-go-MAT-ik)	Form the cheekbones; form the outer walls of the orbits; form the zygomatic arch (on each side of the head) by uniting the zygomatic bone with the zygomatic process of the temporal bone	Greek *zygoma* = yoke	os zygomaticum (sing., TA), cheekbones, jugal bones, malar bones
Nasal Bones *paired bones*	Form the bridge of the nose	Latin *nasus* = nose	os nasale (sing., TA), bridge of nose, nasal eminences
Maxilla Bones *paired bones* (mack-SIH-luh)	Form upper jaw; include the alveolar processes (dental arch containing alveoli and teeth); contain bony sockets (alveoli) for the maxillary teeth; form the main front part of the hard palate (roof of mouth); form part of the nasal cavity walls	Latin *maxilla*, from *mala* = jaw	upper jawbone, superior maxillary bone
Mandible *one bone* (MAN-dih-bul)	Forms the lower jaw; contains the alveolar processes (dental arch containing alveoli and teeth); contains bony sockets (alveoli) for the mandibular teeth; includes the mental protuberance (prominence of chin); includes the mandibular condyles (condylar processes), which form a joint (TMJ) with the mandibular fossa of the temporal bone	Latin *mandibula* = jaw	mandibula (TA), lower jawbone, submaxilla, inferior maxillary bone, inframaxillary bone
Lacrimal Bones *paired bones* (LACK-rih-mal)	Form part of the inside walls of the orbits (eye sockets)	Latin *lacrima* = a tear	os lacrimale (sing., TA)
Vomer Bone *one bone* (VOH-mer)	Forms the lower and back part of the nasal septum	Latin *vomer* = plowshare	—
Inferior Nasal Conchae *paired bones* (in-FEER-ee-or NAY-zul KON-kee)	Scroll-like bones; form part of the lateral walls of the nasal cavity	Latin *inferioris* = lower, below + *nasus* = nose + *concha* = shell	concha nasalis inferior (sing., TA)
Palatine Bones *paired bones* (PAL-uh-tin *or* PAL-uh-teen)	Form back part of hard palate (roof of mouth); form small part of lateral walls of nasal cavity; form small part of walls of orbits (eye sockets); cannot be seen in front (anterior) or side (lateral) views of the skull	Latin *palatum* = palate	os palatinum (sing., TA), palatal bones

Carpal Bones

The carpal bones are eight small bones positioned in two rows in the area of the wrist on each hand.

Proximal Row—From Lateral Side (Outside) to Medial Side (Inside) of Hand in Anatomical Position

BONE	ORIGIN OF TERM	SYNONYMS
Scaphoid (SKAFF-oyd)	Greek *skaphe* = skiff, boat	os scaphoideum (TA), carpal navicular, navicular, naviculare magnus
Lunate (LOO-nate)	Latin *luna* = moon	os lunatum (TA), semi-lunar bone
Triquetral (tri-KWEE-trul)	Latin *triquetrus* = three-cornered, triangular	os triquetrum (TA), triquetrum, triangular bone, cuneiform, pyramidal bone, os pyramidale
Pisaform (PIZ-i-form)	Latin *pisum* = pea + *forma* = shape	os pisiforme (TA)

Distal Row—From Lateral Side (Outside) to Medial Side (Inside) of Hand in Anatomical Position

BONE	ORIGIN OF TERM	SYNONYMS
Trapezium (traa-PEA-zee-yum)	Greek *trapezion* = irregular four-sided shape	os trapezium (TA), greater multangular bone, major multangular bone, os multangulum majus, trapezium bone
Trapezoid (TRAP-eh-zoyd)	Greek *trapezoeides* = shaped like a trapezoid	os trapezoideum (TA), minor multangular, lesser multangular, os multangulum minus
Capitate (KAP-ih-tate)	Latin *caput* = head	os capitatum (TA), os magnum
Hamate (HAM-ate)	Latin *hamulus* = little hook	os hamatum (TA), hamulus, unciform, hooked bone

Tarsal Bones

The tarsal bones are seven bones positioned in two rows (with an intermediate bone between the rows) in the area surrounding the ankle.

Proximal Row—Calcaneus Occupies Most of Hindfoot with Talus Positioned on Top

BONE	ORIGIN OF TERM	SYNONYMS
Calcaneus (kal-KAY-nee-us)	Latin *calcaneum* = heel	calcaneum, os calcis, heel bone
Talus (TAL-us *or* TAY-luss)	Latin *talus* = ankle bone	astragalus, huckle bone

Intermediate Bone

BONE	ORIGIN OF TERM	SYNONYMS
Navicular (nah-VIK-yoo-lar)	Latin navicilaris = relating to shipping, from *navis* = ship	os naviculare (TA), scaphoid, os naviculare pedis

Distal Row—From Medial Side (Inside) to Lateral Side (Outside) of Foot

BONE	ORIGIN OF TERM	SYNONYMS
Medial Cuneiform (KYOO-nee-ih-form)	Latin *cuneus* = wedge + *forma* = shape	os cuneiforme mediale (TA), first cuneiform, os cuneiforme primum, internal cuneiform
Middle Cuneiform (KYOO-nee-ih-form)	Latin *cuneus* = wedge + *forma* = shape	os cuneiforme intermedium (TA), intermediate cuneiform, second cuneiform, os cuneiforme secundum
Lateral Cuneiform (KYOO-nee-ih-form)	Latin *cuneus* = wedge + *forma* = shape	os cuneiforme laterale (TA), third cuneiform, external cuneiform
Cuboid (KYOO-boyd)	Greek *kybos* = cube	os cuboideum (TA)

Joints

Fibrous Joints (Immovable and Slightly Movable Joints)

Origin of term: Latin *fibra* = fiber. Synonyms: junctura fibrosa (TA), articulatio fibrosa
Fibrous joints occur where bones are held together by fibrous connective tissue. There are three types; differences between them have mainly to do with the length of the fibrous tissues.

TYPE OF JOINT	DESCRIPTION/EXAMPLES	ORIGIN OF TERM	SYNONYMS
Suture Joint	Saw-edged, beveled, or overlapping; very short fibers; immovable. Examples: suture joints of the skull.	Latin *sutura* = seam	sutura (TA)
Gomphosis Joint (gom-FOH-siss)	A "peg" in a socket; immovable. Examples: joints connecting the teeth to the upper and lower jaw bones.	Greek *gomphosis* = a nailing together	socket
Syndesmosis Joint (SIN-dez-MOH-siss)	Combines slight movability with strength. Examples: interosseous membranes between the radius and ulna bones of the lower arm and the tibia and fibula bones of the lower legs.	Greek *syndesmos* = a fastening	—

Cartilaginous Joints (Immovable and Slightly Movable Joints)

(KAR-tih-LAAJ-ih-nuss)

Origin of term: Latin *cartilago* = gristle. Synonyms: junctura cartilaginea (TA), articulatio cartilaginis, cartilaginous articulation
Cartilaginous joints occur where bones are connected by cartilage material. There are two types.

TYPE OF JOINT	DESCRIPTION/EXAMPLES	ORIGIN OF TERM	SYNONYMS
Synchondrosis Joint (sin-kon-DROH-siss)	Provides stability; immovable. Example: joint at first costal cartilage (of rib) and sternum.	Greek *syn* = together + *chondros* = cartilage + *osis* = condition	primary cartilaginous joint, synchondrodial joint
Symphysis Joint (SIM-fih-siss)	Occurs on medial line of body; slightly movable. Examples: intervertebral joints of the spinal column, pubic symphysis of pelvis	Greek *symphysis* = a growing together	secondary cartilaginous joint

Synovial Joints (Freely Movable Joints)

(sih-NO-vee-ul)

Origin of term: Greek *syn* = together + Latin *ovum* = egg. Synonyms: articulatio (TA), diarthrosis (TA), junctura synovialis (TA), diarthrodial joint, freely movable joint, movable joint
Synovial joints are enclosed within a joint capsule of fibrous connective tissue that helps strengthen and protect the joint. They are classified according their surface shapes and the degree of movement permitted in the joint area. Some joints provide a greater range of mobility, while others are more stable.

TYPE OF JOINT	DESCRIPTION/MOVEMENT	EXAMPLES	SYNONYMS
Ball-and-Socket Joint	Ball-shaped head of one bone fits into cuplike socket of another bone. Multiaxial movement: flexion and extension, abduction and adduction, rotational movement, circumduction.	Shoulder joint (gleno-humeral joint: glenoid fossa of scapula and humerus); hip joint (head of femur and acetabulum of pelvis)	articulatio spheroidea (TA), spheroid joint, enarthrosis, enarthrodial joint, cotyloid joint
Ellipsoid/Condyloid Joint (ee-LIP-soyd/KON-dih-loyd)	Oval-shaped end of one bone fits into oval-shaped cavity of another bone. Biaxial movement: flexion and extension, abduction and adduction.	Finger joints (metacarpo-phalangeal joints); wrist joint (radio-carpal joint); neck joint (atlas vertebra and cranium: atlanto-occipital joint)	ellipsoid joint: articulatio ellipsoidea (TA); condyloid joint: condylar joint
Gliding Joint	Two bones with slightly flattened surfaces glide across each other. Uniaxial movement (limited, side-to-side movement).	Wrist bones (inter-carpal joints); foot bones (inter-tarsal and sub-talar joints)	articulatio plana (TA), plane joint, arthrodia, arthrodial joint
Hinge Joint	Convex surface of one bone fits into concave surface of another bone. Uniaxial movement: flexion and extension.	Elbow joint (humero-ulnar joint); knee joint (tibio-femoral joint); finger joints (inter-phalangeal joints); toe joints (inter-phalangeal joints); ankle joint (talocrural joint); jaw joint (temporo-mandibular joint, or TMJ)	ginglymus (TA), ginglymoid joint
Pivot Joint	Rounded end of one bone rotates within ringlike structure formed by another bone and ligament. Uniaxial movement: rotation.	Neck joint (atlas and axis vertebrae: atlanto-axial joint); elbow joint (radius and ulna: radio-ulnar joint/proximal)	articulatio trochoidea (TA), swivel joint, rotary joint, rotatory joint, trochoid joint
Saddle Joint	Two ends of bones shaped somewhat like saddles, with concave and convex surfaces. Biaxial movement: flexion and extension, abduction and adduction. (Some experts consider the saddle joint to have triaxial capability: circumduction.)	Base-of-thumb joint (carpo-metacarpal joint of thumb)	articulatio sellaris (TA), sellar joint, reciprocal reception

Agonist and Antagonist Muscles

AGONIST (AND LOCATION)	ANTAGONIST (AND LOCATION)
Biceps brachii with brachialis and brachioradialis (anterior side of upper arm)	Triceps brachii with anconeus (posterior side of upper arm)
Flexor group of forearm (anterior side [palm side] of lower arm)	Extensor group of forearm (posterior side [back-of-hand side] of lower arm)
Left side of external oblique with internal oblique and sacrospinalis on left side (left side of torso)	Right side of external oblique with internal oblique and sacrospinalis on right side (right side of torso)
Rectus abdominis (abdomen)	Sacrospinalis (spinal column)
Gluteus medius with gluteus minimus (buttocks) and tensor fascia latae	Adductor group: adductor longus, adductor brevis, and adductor magnus (posterior and anterior) (inner thigh)
Quadriceps group: vastus lateralis, vastus medialis, vastus intermedius, rectus femoris (front of upper leg)	Hamstring group: biceps femoris, semitendinosus, semimembranosus (back of upper leg)
Gastrocnemius with soleus (back of lower leg)	Tibialis anterior (front of lower leg)

Muscle-Name Terms

The names of muscles very often contain terms that help identify the muscle by the direction of its fibers, its action, its relative size, its shape, the number of heads (or tendons of origin) it has, its attachments, and/or its location relative to bones or body parts or to the planes of the body. The tables on the following four pages summarizes these terms. Note that in many muscle names, different kinds of terms are used in combination.

Direction of Muscle Fibers

These terms indicate the direction of muscle fibers in relation to the medial line.

TERM	MEANING	EXAMPLES
Rectus (REK-tuss)	Straight; fiber direction parallel to the medial line	rectus abdominis (torso) rectus femoris (upper leg)
Oblique (oh-BLEEK)	Fiber direction oblique or diagonal to the medial line	external oblique (torso) internal oblique (torso)
Tranverse (trans-VERSE)	Fiber direction perpendicular to the medial line	transverse abdominis (torso)

Action of Muscle

These terms describe the primary movement of the muscle.

TERM	MEANING	EXAMPLES
Abductor (ab-DUCK-tor)	Moves a body part away from the medial line	abductor digiti minimi (foot) abductor digiti minimi (hand) abductor hallucis (foot) abductor pollicis brevis (hand) abductor pollicis longus (lower arm/hand)
Adductor (ah-DUCK-tor)	Moves a body part toward the medial line	adductor brevis (upper leg) adductor longus (upper leg) adductor magnus (upper leg) adductor pollicis (hand)
Extensor (ek-STEN-sor)	Extends or stretches (opposite of a flexor muscle)	extensor carpi radialis brevis (lower arm) extensor carpi radialis longus (lower arm) extensor carpi ulnaris (lower arm) extensor digitorum (lower arm) extensor digitorum brevis (foot) extensor digitorum longus (lower leg) extensor hallucis brevis (foot) extensor hallucis longus (lower leg) extensor pollicis brevis (lower arm/thumb) extensor pollicis longus (lower arm/thumb)
Flexor (FLEK-sor)	Flexes or bends (opposite of an extensor)	flexor carpi radialis (lower arm) flexor carpi ulnaris (lower arm) flexor digiti minimi brevis (hand) flexor digitorum brevis (foot) flexor pollicis brevis (hand)
Depressor (dee-PRESS-or)	Lowers a body part	depressor anguli oris (face) depressor labii inferioris (face)
Levator (LEV-uh-tor)	Raises a body part	levator labii superioris alaeque nasi (face) levator labii superioris (face)
Pronator (PRO-nay-tor)	Turns a body part downward	pronator teres (lower arm)
Supinator (SOO-pih-nay-tor)	Turns a body part upward	supinator muscle (deep-layer muscle of lower arm)

Muscle-Name Terms, continued

Relative Size of Muscle

These terms indicate the relative size or length of a muscle.

TERM	MEANING	EXAMPLES
Brevis (BREV-iss *or* BREH-viss)	Brief, short	abductor pollicis brevis (hand) adductor brevis (upper leg) extensor carpi radialis brevis (lower arm) extensor digitorum brevis (foot) extensor hallucis brevis (foot) extensor pollicis brevis (lower arm/thumb) flexor digiti minimi brevis (hand) flexor digitorum brevis (foot) flexor pollicis brevis (hand) peroneus brevis (lower leg)
Longus (LON-gus)	Long	abductor pollicis longus (lower arm/thumb) adductor longus (upper leg) extensor carpi radialis longus (lower arm) extensor digitorum longus (lower leg) extensor hallucis longus (lower leg) extensor pollicis longus (lower arm/thumb) palmaris longus (lower arm) peroneus longus (lower leg)
Major (MAY-jur)	Bigger, greater	pectoralis major (torso) rhomboid major (torso) teres major (torso)
Minor (MY-nur)	Smaller, lesser	pectoralis minor (torso) rhomboid minor (torso) teres minor (torso)
Maximus (MACK-sih-muss)	Greatest	gluteus maximus (torso/upper leg)
Medius (MEE-dee-us)	Middle	gluteus medius (torso/upper leg)
Minimus (MIN-ih-muss)	Least, smallest	gluteus minimus (torso/ upper leg)
Minimi (MIN-ih-mee *or* MIN-ih-my)	Smallest, tiniest	abductor digiti minimi (hand) abductor digiti minimi (foot) flexor digiti minimi brevis (hand) opponens digiti minimi (hand)
Magnus (MAG-nuss)	Large	adductor magnus (upper leg)
Vastus (VASS-tuss)	Of great extent	vastus intermedius (upper leg) vastus lateralis (upper leg) vastus medialis (upper leg)

Shape of Muscle

These terms refer to common shapes that muscles resemble.

TERM	MEANING	EXAMPLES
Delta (DEL-tuh)	Triangular (like fourth letter of the Greek alphabet)	deltoid (upper arm)
Orbicularis (or-BICK-yoo-LAR-iss *or* or-BICK-kyoo-LAIR-riss	A disk, circle, orb	orbicularis oculi (face) orbicularis oris (face)
Rhomboid (ROM-boyd)	An oblique parallelogram	rhomboid major (torso) rhomboid minor (torso)
Trapezium (trapezoid) (traa-PEA-zee-um)	A four-sided shape	trapezius (torso)
Serra (SAIR-ruh)	A saw; serrated edge	serratus anterior (torso)
Solea (SOLE-ee-uh)	A flat fish (the sole); the sole of a sandal	soleus (lower leg)

Muscle-Name Terms, continued

Number of Heads or Tendons of Origin

These terms indicate how many muscle heads or tendons of insertion a muscle possesses.

TERM	MEANING	EXAMPLES
Bi	Two	biceps brachii (upper arm) biceps femoris (upper leg)
Tri	Three	triceps brachii (upper arm)
Quad	Four	quadriceps (upper leg)

Muscle Attachments

These terms indicate how many muscle heads or tendons of insertion a muscle possesses.

TERM	MEANING	EXAMPLES
Sterno	Sternum	sternocleidomastoid (muscle that begins on the sternum and clavicle and inserts on the mastoid process of skull)
Cleido	Clavicle	
Mastoid	Mastoid process on skull	
Brachio	Upper arm	brachioradialis (muscle that begins on the upper arm and inserts into the radius bone of the lower arm)
Radialis	Radius bone	

Position of Muscle in Relation to Planes of Body

These terms indicate the position (direction or location) of a muscle in relation to a plane of the body.

TERM	MEANING	EXAMPLES
Lateralis (laa-ter-AL-iss)	Lateral (on the side, away from the median plane)	vastus lateralis (upper leg)
Medialis (mee-dee-AL-iss)	Medial (toward the median plane)	vastus medialis (upper leg)
Intermedius (in-ter-ME-dee-us)	In between; middle	vastus intermedius (upper leg)
Anterior (an-TEER-ee-or)	Before; in front	tibialis anterior (lower leg)
Posterior (pos-TEER-ee-or)	After; behind; in back	tibialis posterior (lower leg)
Dorsi (dorsal, dorsum) (DOOR-sigh *or* DOOR-see)	Back (of, on, along the back)	dorsal interosseous (hand) latissimus dorsi (torso)
Infra (inferior) (IN-fra)	Below; underneath	infraspinatus (torso)
Supra (superior) (SOO-pra)	Above; over	supraspinatus (torso)
External (externus) (ex-TER-nal)	Outward	external oblique (torso)
Internal (internus) (in-TER-nal)	Inward	internal oblique (torso)

Muscle-Name Terms, continued

Location of Muscles in Relation to Bones or Body Regions

These terms refer to a bone or body region where a muscle is located.

TERM	MEANING	EXAMPLES
Abdominis (ab-DOM-ih-niss)	Abdomen	rectus abdominis (torso)
Brachii (brachium) (BRAY-kee-ee *or* BRAKE-ee-eye)	Arm	biceps brachii (upper arm) brachialis (upper arm) brachioradialis (upper arm) triceps brachii (upper arm)
Carpus (carpal, carpi) (KAR-pus)	Wrist	extensor carpi radialis brevis (lower arm) extensor carpi radialis longus (lower arm) extensor carpi ulnaris (lower arm) flexor carpi radialis (lower arm) flexor carpi ulnaris (lower arm)
Digitorum (dij-ih-TOR-um *or* DIJ-ih-TOH-rum)	Digits (fingers, toes, thumbs)	extensor digitorum (lower arm/hand) extensor digitorum brevis (foot) extensor digitorum longus (lower leg) flexor digitorum brevis (foot)
Digiti (DIH-jih-tee)	Digit (finger, toe)	abductor digiti minimi (hand) abductor digiti minimi (foot) flexor digiti minimi brevis (hand) opponens digiti minimi (hand)
Femoris (FEM-o-riss *or* FEM-mor-iss *or* fem-MORE-iss)	Femur (upper leg bone)	biceps femoris (upper leg) rectus femoris (upper leg)
Frontal (FRUN-tul)	Forehead	frontalis (face)
Gluteus (GLOO-tee-us)	Buttocks	gluteus maximus (torso/leg) gluteus medius (torso/leg)
Hallucis (HAL-loo-sis *or* HAL-luck-kiss)	Great toe	abductor hallucis (foot) extensor hallucis brevis (foot) extensor hallucis longus (lower leg)
Oculi (OCK-yoo-lie *or* OCK-yoo-lee)	Eye	orbicularis oculi (face)
Oris (OR-iss)	Mouth	orbicularis oris (face)
Palmaris (pahl-MAR-iss *or* pahl-MAH-riss)	Palm of hand	palmar interosseous (hand) palmaris longus (lower arm)
Pollicis (poe-LEE-siss *or* PAWL-lih-kiss)	Thumb	abductor pollicis brevis (hand) abductor pollicis longus (lower arm/thumb) adductor pollicis (hand) extensor pollicis brevis (lower arm/thumb) extensor pollicis longus (lower arm/thumb) flexor pollicis brevis (hand) opponens pollicis (hand)
Radialis (ray-dee-AA-liss *or* RAY-dee-ah-liss)	Radius (lower arm bone)	brachioradialis (upper and lower arm) extensor carpi radialis brevis (lower arm) extensor carpi radialis longus (lower arm) flexor carpi radialis (lower arm)
Spina (SPY-nah)	Spinal; thorn-like	sacrospinalis (torso)
Temporal (TEM-poor-al)	Pertaining to the temporal bones of the skull (temples)	temporalis (cranium)
Tibialis (tib-ee-AL-iss)	Tibia (shinbone)	tibialis anterior (lower leg)
Ulnaris (ull-NAY-riss)	Ulna (elbow bone of lower arm)	extensor carpi ulnaris (lower arm) flexor carpi ulnaris (lower arm)

Glossary

Notes: (1) In the definitions that follow, the use of SMALL CAPITALS signals that a term appears as a separate entry in this glossary. (2) When searching for a definition, look for the *singular* form of a word: the term *teeth* appears under the entry TOOTH; the term *phalanges* appears under the entry PHALANX. (3) The abbreviation *TA*, in parentheses following a synonym, stands for *Terminologia Anatomica* and indicates that that particular term is the one internationally accepted by the Federation Committee on Anatomical Terminology (FCAT) and the International Federation of Associations of Anatomists (IFAA).

Abdomen (AB-duh-men). The region of the TORSO between the THORAX and the PELVIS. Synonyms: regiones abdominales (TA), abdominal region. Origin of term: Latin *abdomen* = belly.

Abduct (ab-DUKT). To move away from the MEDIAL LINE (CENTRAL AXIS) of the BODY. Synonym: abduce. Origin of term: Latin *abducere* = to lead or take away.

Abduction (ab-DUCK-shun). The action of moving a body part away from the MEDIAL LINE (CENTRAL AXIS) of the BODY. Synonym: abducto (TA). Origin of term: Latin *abducere* = to lead or take away.

Abductor (ab-DUCK-tor). A MUSCLE that moves a body part away from the MEDIAL LINE (CENTRAL AXIS) of the BODY. Origin of term: Latin *abducere* = to lead or take away.

Abductor digiti minimi (of foot) (ab-DUCK-tor DIH-jih-tee MIN-ih-mee *or* ab-DUCK-tor DIJ-ih-tie MIN-ih-my). A MUSCLE that ATTACHES along the LATERAL LONGITUDINAL ARCH of the foot from the CALCANEUS to the PHALANX of the little toe. It ABDUCTS the little toe, pulling it sideways away from the foot. It also helps FLEX the little toe. Synonyms: musculus abductor digiti minimi (TA), abductor digiti minimi pedis, abductor of the little toe. Origin of term: Latin *abducere* = to lead or take away + *digitus* = digit (toe) + *minimi* = smallest.

Abductor digiti minimi (of hand) (ab-DUCK-tor DIH-jih-tee MIN-ih-mee *or* ab-DUCK-tor DIJ-ih-tie MIN-ih-my). The largest MUSCLE of the HYPOTHENAR group of the hand. It ABDUCTS the LITTLE FINGER, pulling it away from the RING FINGER. Synonyms: musculus abductor digiti minimi (TA), abductor digiti quinti, abductor of the little finger. Origin of term: Latin *abducere* = to lead or take away + *digitus* = digit (finger) + *minimi* = smallest.

Abductor hallucis (ab-DUCK-tor HAL-loo-siss *or* ab-DUCK-tor HAL-luc-kiss). A MUSCLE that ATTACHES along the medial arch of the foot from the CALCANEUS to the great toe. It assists in the action of ABDUCTION of the great toe (HALLEX), pulling it away from the MEDIAL LINE of the foot. Synonyms: musculus abductor hallucis (TA), abductor of the great toe (big toe). Origin of term: Latin *abducere* = to lead or take away + *hallex* = great toe.

Abductor pollicis brevis (ab-DUCK-tor poe-LEE-siss BREV-iss *or* ab-DUCK-tor PAWL-lih-kiss BREH-viss). One of the most superficial and largest MUSCLES of the THENAR GROUP of the hand. It moves the THUMB away from the palm, helping in the performance of precise tasks requiring a pincer grip. Synonyms: musculus abductor pollicis brevis (TA), abductor pollicis, short abductor of the thumb, APB. Origin of term: Latin *abducere* = to lead or take away + *pollicis* = of the thumb.

Abductor pollicis longus (ab-DUCK-tor PAWL-lih-kiss LON-gus *or* ab-DUCK-tor poe-LEE-siss LON-gus). One of the extrinsic MUSCLES of the thumb. This deep-layer muscle begins on the RADIUS and ULNA of the FOREARM and inserts into the THUMB. It ABDUCTS the thumb at the CARPO-METACARPAL JOINT (CMC), pulling the thumb forward and away from the palm of the HAND. It also assists in the EXTENSION of the thumb at the CMC joint and in the ABDUCTION of the hand from the wrist (RADIAL ABDUCTION), leaning the hand sideways from the wrist toward the RADIAL side of the arm. Synonyms: musculus abductor pollicis longus (TA), extensor ossis metacarpi pollicis, APL, long abductor of the thumb. Origin of term: Latin *abducere* = to lead or take away + *pollicis* = of the thumb + *longus* = long.

Acetabulum (ah-see-TAB-yoo-lum). A cuplike socket on the PELVIS that is the location of the BALL-AND-SOCKET JOINT of the pelvis and FEMUR. Synonym: cotyloid cavity. Origin of term: Latin *acetabulum* = a shallow vessel or cup for holding vinegar.

Achilles tendon. *See* CALCANEAL TENDON

Acromion of the scapula (ah-KROW-mee-ahn). A bony mass, or tip, at the outer end of the SPINE OF THE SCAPULA that is joined to the outer end of the CLAVICLE and serves as a protective canopy over the BALL-AND-SOCKET JOINT of the SHOULDER GIRDLE. Synonym: acromial process. Origin of term: Greek *akromion* = tip of shoulder.

Adduct (ah-DUKT). To move toward the MEDIAL LINE (CENTRAL AXIS) of the BODY. Origin of term: Latin *addere* = to bring forward.

Adduction (ah-DUCK-shun). The action of moving a body part toward the MEDIAL LINE (CENTRAL AXIS) of the BODY. Synonym: adductio (TA). Origin of term: Latin *addere* = to bring forward.

Adductor (ah-DUCK-tor). A MUSCLE that moves a body part toward the MEDIAL LINE (CENTRAL AXIS) of the BODY. Origin of term: Latin *adductus* = brought forward.

Adductor brevis (ah-DUCK-tor BREH-viss *or* ah-DUCK-tor BREV-iss). One of the MUSCLES of the ADDUCTOR GROUP of the inner thigh. It assists in the ADDUCTION of the THIGH at the HIP JOINT, pulling the abducted upper leg back toward the MEDIAL LINE of the BODY. Synonyms: musculus adductor brevis (TA), short adductor of the thigh. Origin of term: Latin *adductus* = brought forward + *brevis* = short.

Adductor group (ah-DUCK-tor). A MUSCLE GROUP on the inner part of the THIGH that ADDUCTS the abducted FEMUR back toward the MEDIAL LINE (CENTRAL AXIS) of the BODY. The five muscles of the adductor group (ADDUCTOR BREVIS, ADDUCTOR LONGUS, ADDUCTOR MAGNUS, GRACILIS, PECTINEUS) form the inner (medial) portion of the thigh and appear on the surface form as a single muscular mass between the SARTORIUS and the INGUINAL LIGAMENT of the PELVIS region. Synonyms: compartimentum femoris mediale (TA), compartimentum femoris adductorum (TA), adductor compartment of the thigh, medial compartment of the thigh, inner thigh group. Origin of term: Latin *adductus* = brought forward.

Adductor longus (ah-DUCK-tor LON-gus). A large, fan-shaped MUSCLE of the ADDUCTOR GROUP of the inner THIGH. It assists in the ADDUCTION of the upper leg at the HIP JOINT and also participates in the FLEXION of the thigh at the hip joint. Synonyms: musculus adductor longus (TA), long adductor of the thigh. Origin of term: Latin *adductus* = brought forward + *longus* = long.

Adductor magnus (ah-DUCK-tor MAG-nuss). The largest and deepest MUSCLE of the ADDUCTOR GROUP of the inner THIGH. Its massive form contributes to the shape of the inner thigh. It assists in the ADDUCTION of the upper leg at the HIP JOINT, pulling the abducted upper leg back toward the MEDIAL LINE of the BODY, and in the FLEXION the thigh at the hip joint. Its lower portion assists in the EXTENSION of the thigh at the hip joint. Synonyms: musculus adductor magnus (TA), great adductor of the thigh. Origin of term: Latin *adductus* = brought forward + *magnus* = great.

Adductor pollicis (ah-DUCK-tor poe-LEE-siss *or* ah-DUCK-tor PAWL-lih-kiss). A fan-shaped, mostly deep-layer MUSCLE of the THENAR GROUP of the HAND. It has two HEADS: the OBLIQUE head and the TRANSVERSE head. It ADDUCTS the THUMB, bringing it back to the palm from the position of ABDUCTION, in which the thumb is held out away from the palm. Synonyms: musculus adductor pollicis (TA), adductor of the thumb. Origin of term: Latin *adductus* = brought forward + *pollicis* = of the thumb.

Agonist muscle (AG-oh-nist). The primary contracting MUSCLE involved in a particular movement; opposite of ANTAGONIST MUSCLE. Synonyms: prime mover, primary muscle. Origin of term: Greek *agon* = contest.

Alar cartilage of the nose. *See* MAJOR ALAR CARTILAGE OF THE NOSE, MINOR ALAR CARTILAGE OF THE NOSE

Alveolar process (al-VEE-oh-lar). The area of BONE that surrounds and supports the TEETH in the MANDIBLE and MAXILLA. Synonym: alveolar ridge. Origin of term: Latin *alveolus*, diminutive of *alveus* = trough, cavity, hollow.

Alveolus (al-VEE-oh-lus). Any of the small depressions (sockets) in the MANDIBLE and MAXILLA that hold the TEETH. Synonyms: alveolus dentalis (TA), tooth socket. Origin of term: Latin *alveolus*, diminutive of *alveus* = trough, cavity, hollow.

Amphiarthrosis (AM-fee-ar-THROH-siss). A SLIGHTLY MOVABLE JOINT. It can have either fibrous or cartilaginous connective tissues. Origin of term: Greek *amphi* = on both sides + *arthrosis* = jointing.

Anatomical directions/locations. Terms describing the locations of the various body structures (e.g., BONES, MUSCLES) in relation to other structures, when the body is in anatomical position. Synonyms: directional terms, terms of direction, terms of location, locations, terms of position, terms of relation.

Anatomical movements. Terms for the various movements the BODY is capable of performing, such as FLEXION, EXTENSION, ABDUCTION, ADDUCTION, and ROTATION. Synonyms: terms of movement, terms of motion.

Anatomical planes. Three planes—the CORONAL PLANE, SAGITTAL PLANE, and TRANSVERSE PLANE—that are perpendicular to each other and that divide the BODY into front and back (anterior and posterior), right and left, and upper and lower (superior and inferior) portions, respectively. Synonyms: body planes, cardinal planes, planes of reference, planes of movement, planes of sections, principal planes.

Anatomical position. The internationally accepted standard anatomical pose that serves as a point of reference for the locations/directions and positions of anatomical structures. In the anatomical position, the BODY is standing, with feet together and head and palms facing forward. Also, the position of any body part when the figure is in this pose.

Anatomical snuffbox. A triangular depression in the skin on the DORSAL SIDE OF THE HAND near the wrist, formed by TENDONS of the extrinsic THUMB muscles. Synonyms: tabatière anatomique, anatomic snuffbox, radial fossa, foveola radialis. Origin of term: so called because this area was used to hold a pinch of snuff for inhaling.

Anatomy. The branch of medical science that analyzes the physical structure of the human BODY. Origin of term: Greek *anatome* = dissection.

Anconeus (an-KOH-nee-us). A small triangular MUSCLE, located near the ELBOW, that assists the TRICEPS BRACHII in the EXTENSION of the FOREARM. Synonyms: musculus anconeus (TA), anconeus quartus. Origin of term: Greek *ankon* = elbow.

Angle of the mandible. The corner on the lower border of the jaw. Synonyms: angulus mandibulae (TA), angle of jaw, mandible angle.

Angle of a rib. The obvious change of direction in the curvature of a RIB, in the POSTERIOR region of the RIBCAGE. Synonyms: angulus costae (TA), costal angle.

Angular movement. A movement that increases or decreases the angle between two BONES at a particular JOINT. Angular movements include FLEXION, EXTENSION, ABDUCTION, and ADDUCTION.

Ankle joint. The JOINT between the lower ends of the TIBIA and FIBULA bones of the lower LEG and the TALUS TARSAL BONE of the foot. Synonyms: articulatio talocruralis (TA), joint of ankle, mortise joint, talo-crural joint.

Antagonist muscle (an-TAG-oh-nist). A MUSCLE that acts in OPPOSITION to the action produced by an AGONIST MUSCLE, by lengthening or relaxing its MUSCLE FIBERS. Origin of term: Greek *antagonistes* = opponent.

Antebrachium (an-tee-BRAY-kee-um). The anatomical term for the FOREARM. Synonyms: antibrachium, lower arm. Origin of term: Latin *ante* = before, in front of + *brachium* = the arm.

Anterior. Directional term meaning "front" or "toward the front of" the BODY or a body part. Synonyms: front, ventral. Origin of term: Latin: *anterior,* from *ante* = before or in front.

Anterior border of the tibia. The sharp ridge on the front surface of the TIBIA, commonly known as the shin. Synonyms: margo anterior (TA), anterior crest, crista anterior, crest of tibia, anterior margin.

Anterior superior iliac spine, or **ASIS.** Either of the front tips of the ILIAC CRESTS of the PELVIS, which create small bumps on the ANTERIOR surface form of the lower TORSO. Synonyms: spina iliaca anterior superior (TA), anterior superior process of the ilium, anterior superior spine of ilium. Origin of term: Latin *anterior* = in front of + *superioris* = higher + *ilium* = groin, flank + *spina* = spine, thorn. *Compare* POSTERIOR SUPERIOR ILIAC SPINE

Anterior triangle of the neck and shoulder. The triangular space on the front of the neck between the inner borders of the STEROCLEIDOMASTOID muscles and the lower border of the jaw and HYOID BONE. Synonyms: regio cervicalis anterior (TA), trigonum cervicale anterius (TA), trigonum colli anterius (TA), anterior cervical region.

Antihelix (an-tee-HE-liks). An elevated CARTILAGE rim positioned next to or against the outer rim (HELIX) of the ear. Synonyms: inner rim of ear, anthelix. Origin of term: Greek *anti* = against + Latin, from Greek *helix* = a coil.

Antitragus (an-tee-TRAY-gus). A small projection of the CARTILAGE positioned above the LOBE OF THE EAR. Origin of term: Greek *anti* = against + *tragos* = goat. *Compare* TRAGUS

Aponeurosis (AP-oh-new-ROH-siss). A broad, flat sheathing or expanded TENDON that ATTACHES a MUSCLE to BONES or, in some cases, to other structures. Origin of term: Greek *apo* = from + *neuron* = sinew.

Aponeurosis of the external oblique. The sheet-like FASCIA of the EXTERNAL OBLIQUE muscles, which are located on the sides of the TORSO. The APONEUROSIS covers the RECTUS ABDOMINIS muscle. Synonyms: vagina [sheath] musculi recti abdominis (TA), rectus abdominis aponeurosis, rectus sheath (anterior layer), sheath of the rectus abdominis, external oblique aponeurosis.

Aponeurosis of the latissimus dorsi. The sheet-like FASCIA of the LATISSIMUS DORSI, a large MUSCLE of the lower back. Synonyms: lumbar aponeurosis, lumbo-sacral aponeurosis, lumbodorsal fascia.

Appendicular skeleton (AP-en-DIK-yoo-lar). The BONES of the UPPER LIMB and LOWER LIMB (the appendages), which are attached to the AXIAL SKELETON; includes the SHOULDER GIRDLE and PELVIC GIRDLE. Synonyms: skeleton appendiculare (TA), appendicular region. Origin of term: Latin *appendere* = to add on.

Arch(es) of the foot. *See* LATERAL LONGITUDINAL ARCH, MEDIAL LONGITUDINAL ARCH, TRANSVERSE ARCH

Arm. In anatomical terminology, the upper arm but not the FOREARM. In common usage, the word *arm* refers to the whole UPPER LIMB. Synonyms: brachium, humerus bone.

Articulate. To connect with another BONE at a JOINT. Origin of term: Latin *articulare* = to join.

Articulation. Another word for JOINT. Synonyms: articulatio (TA), junctura (TA). Origin of term: Latin *articulare* = to join.

ASIS. *See* ANTERIOR SUPERIOR ILIAC SPINE

Atlas (book). A large book containing drawings, charts, and diagrams. Many early ANATOMY books were in this format. Origin of term: from the name Atlas, the Titan of Greek mythology who supported the heavens or the world on his shoulders.

Atlas (vertebra). The first of the CERVICAL VERTEBRAE. Synonyms: CI (TA), vertebra C1. Origin of term: from the name Atlas, the Titan of Greek mythology who supported the heavens or the world on his shoulders.

Attach. To affix; used in reference to the connection between one anatomical structure (e.g., the TENDON of a MUSCLE) and another (e.g., a BONE).

Attachment. The point at which one anatomical structure is affixed or connected to another. It is usually used in reference to the place where a connective tissue (e.g., an APONEUROSIS, CARTILAGE, LIGAMENT, or TENDON) is affixed to a BONE or other structure. *See also* INSERTION OF A MUSCLE, ORIGIN OF A MUSCLE

Auricle (AW-ree-kul *or* AWR-ih-kul). The anatomical term for the ear. Synonyms: auricula (TA), pinna, ear. Origin of term: Latin *auris* = ear.

Axial skeleton. The BONES forming the CENTRAL AXIS of the BODY: the SKULL, RIBS, and VERTEBRAL COLUMN, including the SACRUM. Synonyms: skeleton axiale (TA), skeleton of the trunk, axial region, central skeleton. Origin of term: Latin *axis* = axle.

Axilla (ak-SILL-ah *or* ak-SIH-la). The anatomical term for the armpit, the depression at the root of the ARM, underneath the SHOULDER JOINT. Synonyms: axillary cavity, hollow of the armpit, pit of the arm. Origin of term: Latin *axilla* = armpit.

Axis (alignment). An imaginary line passing vertically through the center of the BODY or an individual body part (e.g., the TORSO, the head, or an ARM or LEG). Artists use this device to quickly evaluate the general alignment, tilt, or angle of the whole figure or of a specific region. Origin of term: Latin *axis* = axle.

Axis (vertebra). The second of the CERVICAL VERTEBRAE. Synonyms: CII (TA), vertebra C2, vertebra dentata, epistropheus. Origin of term: Latin *axis* = axle.

Ball-and-socket joint. A SYNOVIAL JOINT in which a ball-shaped HEAD on one BONE fits into a cup-like socket on another bone. Synonyms: articulatio spheroidea (TA), spheroid joint, spheroidal joint, enarthrosis, enarthrodial joint, cotyloid joint. *See also* CONDYLOID JOINT, ELLIPSOID JOINT

BCE. Before the common era; an alternative to BC ("before Christ"). Widely used in scholarly writing, BCE designates the period of time before the year 1 in the Gregorian calendar. *Compare* CE

Belly of muscle. The fleshy mass or prominent, thick central part of a MUSCLE. Synonym: venter.

Biaxial joint. A JOINT that moves in two ANATOMICAL PLANES. Origin of term: Latin *bi* = two + *axis* = axle.

Biceps brachii (BI-seps BRAY-kee-ee *or* BI-seps BRAKE-ee-eye). A two-headed MUSCLE located along the entire ANTERIOR portion of the upper ARM. It is one of the principal FLEXORS of the HUMERUS. Synonyms: musculus biceps brachii (TA), biceps flexor cubitus, biceps anticus, biceps, two-headed muscle of the upper arm. Origin of term: Latin *bi* = two + *caput* = head + *brachium* = arm.

Biceps femoris (BI-seps FEM-oh-riss *or* BI-seps FEM-mor-iss *or* BI-seps fem-MORE-iss). A two-headed MUSCLE of the HAMSTRING GROUP of the THIGH. It assists the other hamstring muscles in the EXTENSION of the thigh at the HIP JOINT and the FLEXION of the LEG at the KNEE JOINT. It is also responsible for the LATERAL ROTATION of the TIBIA (when the knee is flexed). The long HEAD of this muscle produces the lateral rotation of the thigh at the hip joint. Synonyms: musculus biceps femoris (TA), biceps flexor cruris, two-headed muscle of the femur. Origin of term: Latin *bi* = two + *caput* = head + *femoris* = pertaining to the femur, thigh.

Bicipital aponeurosis (bi-SIP-ih-tal AP-uh-new-ROH-siss). An offshoot branch of tendinous CONNECTIVE TISSUE near the point of INSERTION of the BICEPS BRACHII muscle. Synonyms: aponeurosis musculi bicipitis brachii (TA), aponeurosis bicipitalis (TA), lacertus fibrosus (TA), semilunar fascia of biceps, bicipital fascia. Origin of term: Latin *bi* = two + *ceps,* from *caput* = head + Greek *apo* = from + *neuron* = sinew.

Bicipital groove (bi-SIP-ih-tal). A trench-like groove on the upper part of the HUMERUS, between the GREATER TUBERCLE and LESSER TUBERCLE, that is occupied by the long TENDON of the BICEPS BRACHII muscle. Synonyms: sulcus intertubercularis (TA), intertubercular groove, intertubercular sulcus, sulcus bicipitalis. Origin of term: Latin *bi* = two + *ceps,* from *caput* = head.

Bicipital tuberosity (bi-SIP-ih-tal TOO-burr-OSS-ih-tee). A small PROMINENCE below the HEAD of the RADIUS bone of the FOREARM that is the INSERTION site for the BICEPS BRACHII muscle. Synonyms: tuberositas radii (TA), radial tuberosity. Origin of term: Latin *bi* = two + *ceps,* from *caput* = head + Latin *turberosus* = full of bumps.

Bipennate muscle fiber (bi-PEN-ate). Muscle fiber arrangement in which the MUSCLE FIBERS are attached on both sides of an elongated TENDON at an OBLIQUE angle, resembling the vanes of a feather. Synonym: musculus bipennatus (TA). Origin of term: Latin *bi* = two + *penna* = feather.

Body. 1. The whole human figure, including the head, neck, TRUNK, and limbs. Synonym: corpus (TA). 2. The main part of a BONE (e.g., the BODY OF THE STERNUM). Synonym: corpus (TA).

Body of the mandible. The main, horseshoe-shaped portion of the lower jawbone (MANDIBLE). Synonym: corpus mandibulae (TA).

Body of a nail. The thin, hard plate covering the DORSAL side of the end of each finger, toe, and THUMB. Synonyms: corpus unguis (TA), unguis, nail plate, onyx, fingernail, toenail, thumb nail.

Body of the sternum (STIR-num). The enlongated middle portion of the breastbone (STERNUM). Synonyms: corpus sterni (TA), gladiolus, mesosternum.

Body of a vertebra (VER-teh-bra). The cylindrical, drum-shaped portion of any of the VERTEBRAE of the VERTEBRAL COLUMN. Synonyms: corpus vertebrae (TA), centrum, vertebral body.

Body types. *See* ECTOMORPH, ENDOMORPH, MESOMORPH

Bone. 1. Hard CONNECTIVE TISSUE containing two basic components: an extracellular MATRIX and bone cells. The extracellular matrix consists of a GROUND SUBSTANCE embedded with collagen fibers and calcified with inorganic mineral/calcium salts. The bone cells inhabit cavities within the hardened matrix. 2. Any of the approximately 206 bones in the adult human BODY. Bones consist of two types of tissue: COMPACT BONE, which forms bones' strong, hard outer surfaces, and SPONGY BONE, which makes up bones' interior structure and gives them their lightness. Synonym: os (TA).

Bony landmark. A place on the BODY where a BONE or part of a bone lies close to the skin, influencing the surface form.

Brachialis (BRAY-kee-al-iss *or* bray-kee-AA-liss). A slightly flattened FUSIFORM MUSCLE of the upper ARM, positioned between the BICEPS BRACHII and TRICEPS BRACHII. It FLEXES the ELBOW JOINT. Synonyms: musculus brachialis (TA), brachialis anticus. Origin of term: Latin *brachialis* = pertaining to the arm.

Brachioradialis (BRAY-kee-oh-ray-dee-AL-iss *or* bray-kee-oh-ray-dee-AA-liss). A prominent MUSCLE of the upper ARM and FOREARM that begins on the outer HUMERUS and spirals downward toward the THUMB side of the wrist. It assists in the FLEXION of the ELBOW JOINT. Synonyms: musculus brachioradialis (TA), supinator radii longus, long supinator, supinator longus. Origin of term: Latin *brachium* = arm + *radialis* = pertaining to the radius bone.

Bridge of the nose. The bony ridge on the upper part of the NASAL BONES. It defines the top plane of the NOSE. Synonyms: dorsum nasi (TA), dorsum of nose.

Brow ridge. The arch-like form along the upper margin of the eye sockets (ORBITS), where the EYEBROWS are positioned. Synonyms: arcus superciliaris (TA), superciliary arches.

Buccinator (BUCK-sin-NAY-tor *or* BUCK-sih-NAY-tor). A flat horizontal MUSCLE that forms the muscular wall of the cheek. When it contracts, it pulls the LIPS tightly across the TEETH and draws the angles of the mouth straight back, resisting distention when blowing or expelling air through the lips. Musicians of wind and brass instruments utilize this muscle. Synonyms: musculus buccinator (TA), trumpeter's muscle. Origin of term: Latin *bucina* = trumpet.

Bursa (BUR-sah). A small fibrous sac, filled with SYNOVIAL FLUID, that is located within a JOINT or between BONES and TENDONS and that reduces friction during movement. Synonyms: bursa synovialis (TA), synovial bursa. Origin of term: Medieval Latin *bursa* = purse.

Calcaneal tendon (kal-KAY-nee-ul TEN-din). The TENDON of the GASTROCNEMIUS and SOLEUS muscles of the lower LEG whose INSERTION is into the heel bone (CALCANEUS). It is more commonly known as the Achilles tendon. Synonyms: tendo calcaneus (TA), tendon of Achilles, tendo Achilles, heel tendon.

Calcaneal tuberosity (kal-KAY-nee-ul TOO-ber-OSS-ih-tee *or* kal-KAY-nee-ul TOO-ber-ROSS-ih-tee). The bulky POSTERIOR projection of the heel bone (CALCANEUS), which forms the PROMINENCE of the heel and is an ATTACHMENT site for the CALCANEAL TENDON. Synonym: tuber calcanei (TA). *See also* TUBEROSITY

Calcaneus (kal-KAY-nee-us). The large TARSAL BONE of the foot that forms the heel. Synonyms: heel bone, calcaneum. Origin of term: Latin *calcaneum* = heel bone.

Calcification. The formation of hard BONE from soft TEMPORARY CARTILAGE by the deposition of inorganic minerals into the MATRIX of the CARTILAGE. Synonym: calcarous infiltration.

Canine (KAY-nine). Any of the four TEETH (two on each DENTAL ARCH) that are positioned beside the INCISORS and have a conical shape. Synonyms: dens caninus (TA), cuspid, eye tooth, fang. Origin of term: Latin *caninus,* from *canis* = dog.

Canon of proportion. A mathematical system, or formula, used by artists for the measurement of the human BODY. Origin of term: Latin *canon* = a measuring line (ruler) / *proportio,* from *pro* = for + *portio* = part or share.

Capitate (KAP-ih-tate). The largest CARPAL BONE of the DISTAL ROW in the wrist region. Synonyms: os capitatum (TA), os magnum. Origin of term: Latin *caput* = head.

Capitulum (kah-PITCH-yoo-lum). A small, sphere-shaped form on the lower end of the HUMERUS. It articulates with the RADIUS, helping to form the ELBOW JOINT. Synonyms: capitulum humeri (TA), capitellum of humerus. Origin of term: Latin *capitulum* = little head.

Carpal bones (KAR-poll). The collective name for the eight small BONES of the wrist region: the CAPITATE, HAMATE, LUNATE, PISAFORM, SCAPHOID, TRAPEZIUM, TRAPEZOID, and TRIQUETRAL. Synonyms: ossa carpi (TA), ossa carpalia (TA), carpus (singular), carpi (plural). Origin of term: Latin *carpus,* from Greek *karpos* = wrist.

Carpal tunnel. An arching passageway under the canopy formed by the FLEXOR RETINACULUM ligament, which attaches on the CARPAL BONES of the wrist. The flexor TENDONS of the HAND muscles pass through this tunnel-like structure. Synonyms: canalis carpi (TA).

Carpo-metacarpal joint, or **CMC joint** (KAR-poe-met-tah-KAR-poll). The JOINT between a CARPAL BONE of the wrist and a METACARPAL BONE of the HAND. Synonyms: articulationes carpometacarpales (TA), articulationes carpometacarpea. Origin of term: Latin *carpus,* from Greek *karpos* = wrist + *meta* = after + Latin *carpus.*

Cartilage (KAR-tih-lij). A CONNECTIVE TISSUE found in JOINTS, where it acts as a shock absorber, and in the ear, LARYNX, NOSE, and RIBCAGE ARCH, where it serves a structural purpose. There are three types: ELASTIC CARTILAGE, FIBROUS CARTILAGE, and HYALINE CARTILAGE. Synonym: cartilago (TA). Origin of term: Latin *cartilago* = gristle.

Cartilaginous joint (KAR-tih-laaj-ih-nuss). An IMMOVABLE JOINT or SLIGHTLY MOVABLE JOINT in which the BONES are connected by CARTILAGE material. Synonyms: junctura cartilaginea (TA), articulatio cartilaginis, cartilaginous articulation.

CE. The common era; an alternative to AD (from Latin *anno dominis* = year of our lord). Widely used in scholarly writing, CE designates the period of time after the year 1 in the Gregorian calendar. *Compare* BCE

Central axis of the body. The imaginary MEDIAL LINE that divides the BODY vertically into equal right and left halves. Synonyms: mid-sagittal plane, mid-line of the body.

Ceroplasty (see-row-PLASS-tee). The art of making lifelike anatomical models in wax. Ceroplasty was first used in seventeenth-century Italy.

Cervical vertebrae (SIR-vih-kull VER-teh-bree *or* SIR-vick-ul VER-teh bray). The seven VERTEBRAE of the neck region. Synonyms: vertebrae cervicales (TA), CI–CVII, C1–C7. Origin of term: Latin *cervix* = neck + *vertebra,* from *verto* = turn.

Chest. The *anterior* wall of the *ribcage*, or *thorax*, region. Synonym: pectus.

Chirology (kigh-RAHL-oh-gee). The art of divination through the study or analysis of the HAND. Synonyms: palmistry, palm reading, chiromancy, hand analysis. Origin of term: Greek *chiro,* from *cheir* = hand + *logos,* from *legein* = to speak.

Circular muscle fiber. Muscle fiber arrangement in which the MUSCLE FIBERS are positioned in concentric rings surrounding an opening or orifice. Synonyms: musculus orbicularis (TA), orbicular muscle.

Circumduction (sir-kum-DUCK-shun). The circular movement of the entire ARM or LEG in which the limb moves through all the ANATOMICAL PLANES. Synonyms: circumductio (TA), cycloduction. Latin *circum* = around + *docere* = to lead, to draw.

Clavicle (KLAV-ih-kull). Either of two slightly curved LONG BONES, on either side of the STERNUM, that form part of the SHOULDER GIRDLE. Synonyms: clavicula (TA), collarbone. Origin of term: Latin *clavicula* = a small key.

CMC joint. *See* CARPO-METACARPAL JOINT

Coccyx (KOCK-six). The tailbone, which consists of three or four fused rudimentary VERTEBRAE at the base of the SACRUM. Synonyms: os coccygis (TA), vertebrae coccygeae (TA), coccygeal vertebrae. Origin of term: Greek *kokkux* = cuckoo (because of its resemblance to a cuckoo's beak).

Compact bone. The type of osseous CONNECTIVE TISSUE that forms the strong, hard outer surfaces of BONES. Synonyms: substantia compacta (TA), compact substance, dense tissue.

Compartments. MUSCLE GROUPS that are partitioned off from each other by membranes called INTERMUSCULAR SEPTA. Compartments are identified by their movement functions (ADDUCTOR, EXTENSOR, FLEXOR) or by their positions on the BODY (ANTERIOR, LATERAL, MEDIAL, POSTERIOR).

Concha (KON-kah). The bowl-like CARTILAGE structure of the ear. Synonyms: concha auriculae (TA), concha of ear, concha of auricle, bowl of ear. Origin of term: Latin *concha* = shell.

Condylar process of the mandible (KON-dih-lar). The CONDYLE of the MANDIBLE, which ARTICULATES with the TEMPORAL BONE of the SKULL to create the TEMPORO-MANDIBULAR JOINT, or TMJ. Synonyms: processus condylaris (TA), mandibular condyle, condyle of mandible.

Condyle (KON-dial). A large, rounded projection at the extremity of a BONE that forms part of an articulated JOINT. Condyles usually occur in pairs. Synonym: condylus (TA). Origin of term: Latin *condylus,* from Greek *kondylos* = knob, knuckle.

Condyles of the femur. Two large, smooth, rounded projections (the medial and lateral condyles) at the lower end of the FEMUR. Synonyms: medial condyle: condylus medialis (TA), inner condyle; lateral condyle: condylus lateralis (TA), external condyle.

Condyloid joint (KON-dih-loyd). A SYNOVIAL JOINT in which the oval-shaped end (CONDYLE) of one BONE fits into the oval-shaped cavity of another bone. Synonyms: articulatio ellipsoidea (TA), ellipsoid joint, condylar joint. *See also* ball-and-socket joint, ellipsoid joint

Conjunctiva (kon-junk-TIE-vah). The mucous membrane covering the front surface of the EYEBALL and the back surface of the EYELIDS. Synonyms: tunica conjunctiva (TA), bulbar conjunctiva, tunica conjunctiva bulbi. Origin of term: Latin *conjungere* = to join together.

Connective tissue. Tissue that binds, supports, or connects various structures within the BODY. Connective tissues include BONE, CARTILAGE, LIGAMENTS, TENDONS, APONEUROSES, FASCIA, and SUBCUTANEOUS FAT. Each of the various forms contains its own unique extracellular MATRIX, which is composed of a GROUND SUBSTANCE (a gel-like background material) with embedded fibers (e.g., collagen, elastic fibers, etc.); individual connective-tissue cells are dispersed within the matrix. The proportions and arrangement of these components vary widely from one type of connective tissue to another, making some connective tissues (such as the cartilage of the NOSE) flexible while others (such as BONE) are more rigid.

Contraction of muscle. The shortening of MUSCLE FIBERS that causes body parts to move.

Contrapposto (KON-trah-post-toe *or* kon-treh-POHS-toe). A classical standing pose in which the body's weight is concentrated on one LEG while the other knee is bent, creating a tilt in the PELVIS. This produces a counterbalancing reaction in the shoulders, which tilt slightly in opposition to the hips. Origin of term: Italian *contrapposto* = counterpoise.

Convergent muscle fiber. Fan-shaped MUSCLE FIBER arrangement in which the fibers are spread widely at their ORIGIN but taper (converge) into a single TENDON of INSERTION. Synonyms: musculus triangularis (TA), radiated muscle, triangular muscle. Origin of term: Latin *convergere* = to incline together.

Coracoid process of scapula (KOR-ah-koyd). A beak-like protrusion of bone on the shoulder blade (SCAPULA). Synonym: processus coracoideus (TA). Origin of term: Greek *korax* = a crow's beak + *eidos* = resemblance.

Cornea (KOR-nee-ah). A transparent tissue on the front outer wall of the EYE, covering the IRIS and PUPIL. Origin of term: Latin *corneus* = horn.

Coronal plane (KOR-uh-nul). The ANATOMICAL PLANE that vertically divides the body into equal front (ANTERIOR) and back (POSTERIOR) portions. Synonyms: plana frontalia (TA), plana coronalia (TA), frontal plane, anterior plane. Origin of term: Latin *corona* = crown, garland.

Coronoid process of the mandible (KOR-o-noyd). A small, sharp, triangular projection, resembling a shark's fin, occurring on each RAMUS of the MANDIBLE. Synonym: processus coronoideus (TA). Origin of term: Greek *koronos* = crown + *eidos* = resemblance.

Corrugator supercilii (KOR-uh-GATE-or soo-per-SIL-ee-eye *or* KOR-ah-gay-tor soo-per-SIL-lee-ee). A small oblique FACIAL MUSCLE positioned on the BROW RIDGE underneath the ORBICULARIS OCULI muscle. It assists the PROCERUS muscle in the DEPRESSION of the inner ends of the EYEBROWS. Synonyms: musculus corrugator supercilii (TA), corrugator of the eyebrow, frowning muscle, the muscle that wrinkles the eyebrow. Origin of term: Latin *corrugare* = to wrinkle up + *superus* = above + *cilium* = eyebrow.

Costal cartilage (KOS-tul). HYALINE CARTILAGE that connects a RIB into the STERNUM. Synonyms: cartilago costalis (TA), costochondral. Origin of term: Latin *costa* = rib.

Cranial bones. The twenty-two BONES of the SKULL, including the eight bones that construct the ostrich-egg shape of the CRANIUM and the fourteen FACIAL BONES. Synonyms: ossa cranii (TA), bones of the skull, bones of the cranium, craniofacial bones.

Cranial floor. The bony floor of the CRANIUM, on which the brain is securely positioned. Synonyms: basis cranii (TA), cranial base, basicranium.

Cranial vault. The bony roof of the CRANIUM. Synonyms: calvaria (TA), skullcap, dome of skull.

Cranium (KRAY-nee-um). The ostrich egglike part of the SKULL, which encases the brain. The cranium consists of eight bones. In common usage, the term *cranium* pertains to the whole skull. Synonyms: skull, neurocranium (TA), braincase, brainbox, cranial bones. Origin of term: Latin *cranium,* from Greek *kranion* = skull.

Crest. A narrow ridge on the surface of a BONE. Synonym: crista (TA). Origin of term: Latin *crista* = a comb or tuft on the head of a bird.

Cricoid cartilage (CRY-koyd). Cartilaginous structure of the LARYNX that is shaped like a signet ring. Synonym: cartilago cricoidea (TA). Origin of term: Latin *cricoideus,* from Greek *krikos* = finger ring + Greek *eidos* = resemblance + Latin *cartilago* = gristle.

Cubital fossa (KYOO-bih-tul FOSS-ah). A triangular depression in the skin of the ANTERIOR portion of the ARM, near the crease of the ELBOW JOINT. Synonyms: fossa cubitalis (TA), ante-cubital fossa, hollow of the elbow, pit of the elbow. Origin of term: Latin *cubitus* = elbow + *fossa* = trench, ditch.

Cuboid bone (KYOO-boyd). A TARSAL BONE in the DISTAL ROW on the LATERAL side of the foot. Synonym: os cuboideum (TA). Origin of term: Greek *kybos* = cube.

Cuneiform bones. (KYOO-nee-ih-form *or* kyoo-NEE-ih-form). Three wedge-shaped TARSAL BONES of the DISTAL ROW. They are the lateral cuneiform (syn., os cuneiform laterale [TA], external cuneiform, third cuneiform), the intermediate cuneiform (syn., os cuneiform intermedium [TA], os cuneiform secundum, middle cuneiform, second cuneiform), and the medial cuneiform (syn., os cuneiform mediale [TA], os cuneiforme primum, internal cuneiform, first cuneiform). Origin of term: Latin *cuneus* = wedge + *forma* = shape.

Cupid's bow. The margin of the upper LIP whose curved contour resembles an archer's bow.

Cuspid (KUSS-pid). A TOOTH having one cusp, or point; a CANINE tooth. Synonyms: dens caninus (TA), cuspid dentis (TA), cusp, eyetooth. Origin of term: Latin *cupis* = point, spike.

Cuticle. The border of thin skin around the base and sides of the nail on a finger, THUMB, or toe. Synonyms: cuticula (TA), eponychium. Origin of term: Latin *cuticula,* diminutive of *cutis* = skin.

Deep fascia (FASH-ee-ah *or* FAY-shee-ah). Thin fibrous FASCIA, devoid of fat, that encases and binds together MUSCLES and MUSCLE GROUPS. Synonyms: fasciae musculorum (TA), fascia of muscles, muscular fascia.

Deep layer of muscles. Those MUSCLES that are located away from the body surface and positioned beneath the SUPERFICIAL LAYER OF MUSCLES, which is nearer the skin or surface form. Synonym: profundus (TA).

Deltoid (DELL-toyd). The triangular MUSCLE of the shoulder and upper ARM. It assists in the actions of raising the arm horizontally (ABDUCTION) and raising the arm out in front of the BODY (FLEXION) and contributes to the action of moving the arm back behind the TORSO (EXTENSION). The deltoid has three portions: the anterior portion (syn., clavicular portion), lateral portion (syn., acromial portion), and posterior portion (syn., spinal portion). Synonym (for whole muscle):

musculus deltoideus (TA). Origin of term: Greek *delta* = triangle-shaped fourth letter of Greek alphabet.

Deltoid tuberosity (DELL-toyd TOO-ber-OSS-ih-tee *or* DELL-toyd TOO-ber-ROSS-ih-tee). A textured area about midway along the lateral side of the HUMERUS that is the INSERTION site of the DELTOID muscle. Synonyms: tuberositas deltoidea (TA), deltoid impression. *See also* TUBEROSITY

Dental arch. Either of the curving bony structures in the MAXILLA and MANDIBLE that contain the TEETH. Synonyms: upper arch: arcus dentalis maxillaris (TA), arcus dentalis superior (TA), maxillary dental arcade, upper dental arcade; lower arch: arcus dentalis mandibularis (TA), arcus dentalis inferior (TA), mandibular dental arcade, lower dental arcade. Origin of term: Latin *dens* = tooth.

Dentin (DEN-teen). A mineralized CONNECTIVE TISSUE that forms the BODY of the TOOTH, beneath the ENAMEL covering. Synonym: dentinum (TA). Origin of term: Latin *dens* = tooth.

Depress. To lower, move downward. Origin of term: Latin *deprimire* = to press down.

Depression. The action of moving a body part in a downward (INFERIOR) direction. Origin of term: Latin *deprimere* = to press down.

Depressor. A MUSCLE that moves a body part in a downward (INFERIOR) direction. Origin of term: Latin *deprimere* = to press down.

Depressor anguli oris (dee-PRESS-or ANG-yoo-lie OR-iss *or* dee-PREH-sor AN-gyoo-lee OR-iss). A triangular MUSCLE on the lower jaw that inserts into the angle of the mouth. It draws the corners of the mouth downward. Synonyms: depressor anguli oris (TA), triangularis, triangularis menti, depressor of the angle of the mouth. Origin of term: Latin *deprimere* = to press down + *anguli* = of angles + *oris* = of the mouth.

Depressor labii inferioris (dee-PRESS-or LAY-bee-eye in-FEAR-ee-or-iss *or* dee-PREH-sor lay-bee-eye in-FEAR-ee-OR-iss). A small quadrilateral MUSCLE that is located on the lower jaw and inserts into the skin of the lower LIP. It draws the lower lip downward. Synonyms: musculus depressor labii inferioris (TA), quadratus menti, quadratus labii inferioris, depressor of the lower lip. Origin of term: Latin *deprimere* = to press down + *labium* = lip + inferioris = lower, below.

Diarthrosis (die-ar-THROH-siss). A SYNOVIAL JOINT. Synonyms: junctura synovialis (TA), articulatio (TA), freely movable joint.

Digastric (die-GAS-trik). A two-bellied MUSCLE (united by a central TENDON) located on the bottom plane of the lower jaw. It helps lower (DEPRESS) the MANDIBLE in the action of opening the mouth. Synonyms: musculus digastricus (TA), digastricus, biventer mandibulae. Origin of term: Greek *di* = two + *gastro* = of or relating to the belly.

Digit. A finger, toe, or THUMB. Synonyms: digitus (TA), dactyl, dactylus. Origin of term: Latin *digitus* = digit (finger or toe).

Digital crease. A crease or furrow on the skin of a finger at the level of a JOINT.

Digitation. A structural arrangement, as of the MUSCLE FIBERS of certain MUSCLES, resembling fingers. Latin *digitus* = digit (finger).

DIP joint. *See* DISTAL INTER-PHALANGEAL JOINT

Distal (DISS-tul). A location term referring to the part of an ARM, LEG, HAND, foot, finger, or toe that is farthest from that body part's point of attachment. Synonym: distalis (TA). Origin of term: Latin *distare* = to stand distant from. *Compare* PROXIMAL

Distal inter-phalangeal joint, or **DIP joint.** The INTER-PHALANGEAL JOINT that is farthest from a finger or thumb's attachment on the HAND or a toe's attachment on the foot. *Compare* PROXIMAL INTER-PHALANGEAL JOINT

Distal palmar crease. A crease on the PALMAR SIDE OF THE HAND that travels more or less horizontally along the padding near the fingers. Synonyms: heart line, transverse distal crease, fold of the fingers, line of the fingers.

Distal row of carpal bones. The row of CARPAL BONES (containing the TRAPEZIUM, TRAPEZOID, CAPITATE, and HAMATE) positioned farther from the wrist and closer to the METACARPAL BONES of the HAND. *Compare* PROXIMAL ROW OF CARPAL BONES

Distal row of tarsal bones. The row of TARSAL BONES (containing the three CUNEIFORM BONES and the CUBOID) positioned farther from the ankle and closer to the METATARSAL BONES of the foot. *Compare* NAVICULAR, PROXIMAL ROW OF TARSAL BONES

Dorsal (DOOR-sull). A location term referring to the back, or POSTERIOR, surface of an anatomical structure or of the whole BODY; also refers to the top surface of the foot. Synonyms: dorsalis (TA), posterior, dorsum. Origin of term: Latin *dorsum* = back

Dorsal interosseus muscles (DOOR-sul in-tur-OSS-see-us *or* DOOR-sul in-tur-ROSS-ee-us). Four MUSCLES that ATTACH to the sides of the METACARPAL BONES, nearer the back of the HAND. They ABDUCT the fingers, spreading them apart. The first dorsal interosseous muscle assists in the ADDUCTION of the THUMB. Synonyms: musculi interossei dorsales (TA; plural form), interosseus dorsalis manus. Origin of term: Latin *dorsum* = back + *interosseous* = between the bones.

Dorsal side of the foot. The top, or upper portion, of the foot, opposite the PLANTAR SIDE. Synonyms: dorsum pedis (TA), regio dorsalis pedis (TA), dorsal region of the foot, dorsum of foot.

Dorsal side of the hand. The back of the hand, opposite the PALMAR SIDE. Synonyms: dorsum manus (TA), regio dorsalis manus (TA), back of the hand, dorsum of hand.

Dorsiflexion (door-sih-FLEK-shun). A movement of the foot from the ANKLE JOINT in which the DORSAL SIDE OF THE FOOT is lifted, with the toes pointing upward. Origin of term: Latin *dorsum* = back + *flectere* = to bend.

Earlobe. *See* LOBE OF THE EAR

Ear notch. A notch on the ear CARTILAGE between the two small bumps (TRAGUS and ANTITRAGUS) near the LOBE OF THE EAR. Synonyms: incisura intertragica (TA), intertragic notch, intertragic incisure.

Écorché (ay-kor-SHAY *or* AY-kor-shay). A two- or three-dimensional depiction of a flayed BODY or body part in which the skin has been removed for the study of the SUPERFICIAL LAYER OF MUSCLES. Origin of term: French *écorché* = flayed.

Ectomorph (EK-toe-morf). One of the three basic body types; characterized by a tendency to be thin and lean. The ectomorph's BONES are usually light and relatively noticeable on the surface form because of the comparative lack of fatty tissue. The limbs, HANDS, face, and neck tend to be long and thin. Origin of term: Greek *ektos* = outside + *morphe* = form.

Elastic cartilage. A type of flexible CARTILAGE that retains its shape. The external ear consists mainly of elastic cartilage. Synonyms: yellow cartilage, yellow fibrocartilage.

Elbow. The common name for the OLECRANON the bump-like form of the ULNA near the ELBOW JOINT. Synonyms: olecranon process of ulna, point of elbow, cubitus.

Elbow joint. The SYNOVIAL JOINT between the lower end of the HUMERUS bone of the upper ARM and the upper ends of the RADIUS and ULNA bones of the FOREARM. Synonyms: articulatio cubiti (TA), cubital joint.

Elevate. To move a body part upward, in a SUPERIOR direction. Origin of term: Latin *elevare* = to raise, to lift.

Elevation. The action of moving a body part upward, in a SUPERIOR direction. Origin of term: Latin *elevare* = to raise, to lift.

Elevator. A MUSCLE that moves a body part upward, in a SUPERIOR direction. Origin of term: Latin *elevare* = to raise, to lift. *See also* LEVATOR

Ellipsoid joint (ee-LIP-soyd). A SYNOVIAL JOINT in which the end of one BONE, shaped like an elongated oval, fits into the elongated-oval-shaped cavity of another bone. Synonyms: articulatio ellipsoidea (TA), condylar joint, condyloid joint, condyloid articulation. Origin of term: Greek *ellipeipsis* = an ellipse + *eidos* = resemblance. *See also* BALL-AND-SOCKET JOINT, CONDYLOID JOINT

Eminence. An anatomical form or area that is raised above a flatter, surrounding surface, as in the THUMB eminence of the PALMAR SIDE OF THE HAND, which is formed by the THENAR GROUP muscles. Synonym: eminentia (TA). Origin of term: Latin *eminentia* = a standing out, prominence.

Enamel. The hard, glossy, ivory-like substance covering the crown of a TOOTH, overlying the DENTINE. Origin of term: Archaic French *enameller* = to apply enamel.

Endomorph (EN-doh-morf). One of the three basic body types; covers a range of subtypes from slightly plump and fleshy, to portly and stout, to extremely heavy and obese. This endomorph's fatty tissue softens out most of the MUSCLE definition. Origin of term: Greek *endon* = within + *morphe* = form.

Epicanthic fold (ep-ih-KAN-thik *or* eh-pa-KAN-thik). A fold of the upper EYELID that overlaps the inner corner of the EYE. Synonyms: epicanthus, epicanthal fold, internal fold, medial canthic fold. Origin of term: Greek *epi* = at, on, upon + *kanthos* = corner of eye.

Epicondyle (ep-ih-KON-dial). A small projection above a CONDYLE on the surface of a BONE. Synonym: epicondylus (TA). Greek *epi* = at, on, upon + *kondylos* = knuckle.

Epicondyles of the humerus. Two prominent projections (the lateral epicondyle and the medial epicondyle) on either side of the lower end of the HUMERUS.

Epicranial aponeurosis (ep-ih-KRAY-nee-ul AP-uh-new-ROH-siss). The skullcap-like sheathing connecting the FRONTALIS muscle on the forehead to the OCCIPITALIS muscle on the back of the CRANIUM. Synonyms: galea aponeurotica (TA), aponeurosis epicranialis (TA), galea. Origin of term: Greek *epi* = at, on, upon + Latin *cranium*, from Greek *kranion* = skull + Greek *apo* = from + *neuron* = sinew.

Epigastric fossa (ep-ih-GAS-trik FOSS-ah). A small depression near the base (XIPHOID PROCESS) of the STERNUM. Synonyms:

epigastrium (TA), fossa epigastrica (TA), regio epigastrica (TA), epigastrium depression, epigastric region, intersternal depression, pit of the stomach. Origin of term: Greek *epi* = at, on, upon + *gaster* = belly + Latin *fossa* = trench, ditch.

Eponym (EP-oh-nim). In ANATOMY, a name of a BONE, MUSCLE, or other structure that is derived from the name of the person who first described or discovered it (e.g., angle of Louis) or from the name of a historical or mythical person (e.g., Achilles tendon). Eponymic terms for anatomical structures have gradually fallen out of favor in the medical community, being replaced by terms that more clearly identify the structure by its location or function.

Ethmoid bone (ETH-moyd). A bone of the CRANIUM that forms part of the NASAL CAVITY and NASAL SEPTUM. Synonyms: os ethmoidale (TA), ethmoidal bone. Origin of term: Greek *ethmos* = sieve + *eidos* = resemblance.

Eversion (ee-VER-zhun). A movement of the foot in which the sole (PLANTAR SIDE) is turned outward or laterally (away) from the MEDIAL LINE (CENTRAL AXIS) of the BODY. Origin of term: Latin *evertere* = to turn out, to twist about.

Extend. To straighten out a body part (such as a limb) from a bent, or flexed, position. Origin of term: Latin *extendere* = to stretch out.

Extension. The action of straightening out a body part from a bent, or flexed, position. Synonym: extensio (TA). Origin of term: Latin *extendere* = to stretch out.

Extensor (ek-STEN-sor). A MUSCLE that causes a body part or structure to straighten or extend; the ANTAGONIST of a FLEXOR. Origin of term: Latin *extendere* = to stretch out.

Extensor carpi radialis brevis (ek-STEN-sor KAR-pea ray-dee-AA-liss BREH-viss *or* ek-STEN-sor KARP-eye RAY-dee-ah-liss BREV-iss). A MUSCLE of the FOREARM, positioned on the POSTERIOR side. Its ORIGIN is on the lateral EPICONDYLE OF THE HUMERUS, and it inserts into the third METACARPAL BONE of the HAND. It assists in the EXTENSION of the hand at the WRIST JOINT and in the ABDUCTION of the hand (RADIAL ABDUCTION), leaning the hand sideways from the wrist toward the RADIAL side of the arm. Synonyms: musculus extensor carpi radialis brevis (TA), extensor carpi radialis brevior, radialis externus brevis, ECRB, short extensor of the wrist on the radial side. Origin of term: Latin *extendere* = to stretch out + Latin *carpus*, from Greek *karpos* = wrist + Latin *radialis* = pertaining to the radius bone + *brevis* = short.

Extensor carpi radialis longus (ek-STEN-sor KAR-pea ray-dee-AA-liss LON-gus *or* ek-STEN-sor KARP-eye RAY-dee-ah-liss LON-gus). An elongated MUSCLE that begins on the HUMERUS and spirals downward to attach into the second METACARPAL BONE of the HAND. It helps in the EXTENSION of the hand at the WRIST JOINT and also helps ABDUCT the hand at the wrist joint (RADIAL ABDUCTION), leaning the hand sideways from the wrist on the RADIAL side of the arm. Synonyms: musculus extensor carpi radialis longus (TA), external carpi radialis longior, radialis externus longus, ECRL, long extensor of the wrist on the radial side. Origin of term: Latin *extendere* = to stretch out + *carpus*, from Greek *karpos* = wrist + Latin *radialis* = pertaining to the radius bone + *longus* = long.

Extensor carpi ulnaris (ek-STEN-sor KAR-pea ull-NAY-riss *or* ek-STEN-sor KARP-eye ull-NAY-riss). A long FUSIFORM MUSCLE positioned mostly on the MEDIAL side of the FOREARM. It helps EXTEND the HAND at the WRIST JOINT and also helps ADDUCT the hand at the wrist joint (ULNAR ADDUCTION), leaning the hand sideways from the wrist joint toward the ULNAR side of the arm. Synonyms: musculus extensor carpi ulnaris (TA), ulnaris externus, ECU, extensor of the wrist on the ulnar side. Origin of term: Latin *extendere* = to stretch out + *carpus*, from Greek *karpos* = wrist + Latin *ulnaris* = pertaining to the ulna bone.

Extensor digitorum (ek-STEN-sor dij-ih-TOR-um). A MUSCLE of the POSTERIOR side of the FOREARM that attaches on the lateral EPICONDYLE OF THE HUMERUS and travels downward to split into four TENDONS, each of which inserts into a finger. It is the primary mover in the EXTENSION of the fingers from the METACARPO-PHALANGEAL JOINTS. It also assists in moving the individual finger joints (the INTER-PHALANGEAL JOINTS) and contributes to the extension of the wrist, pulling the HAND back from a flexed position. Synonyms: musculus extensor digitorum (TA), external digitorum, external communis digitorum, extensor digitorum communis, extensor of the fingers. Origin of term: Latin *extendere* = to stretch out + *digitorum* = pertaining to the digits (fingers).

Extensor digitorum brevis (ek-STEN-sor dij-ih-TOR-um BREV-iss *or* ek-STEN-sor dij-ih-TOR-um BREH-viss). A four-bellied MUSCLE positioned on the DORSAL SIDE OF THE FOOT. It helps EXTEND (straighten) the four lesser toes from a flexed (bent) position. Synonyms: musculus extensor digitorum brevis (TA), extensor brevis digitorum pedis, extensor brevis digitorum, short extensor of the toes. Origin of term: Latin *extendere* = to stretch out + *digitorum* = pertaining to the digits (toes) + *brevis* = short.

Extensor digitorum longus (ek-STEN-sor dij-ih-TOR-um LON-gus). A MUSCLE on the ANTERIOR side of the lower LEG whose four TENDONS insert into the four lesser toes. It extends the toes and lifts the foot upward from the ANKLE JOINT in the movement of DORSIFLEXION. Synonyms: musculus extensor digitorum longus (TA), extensor longus digitorum pedis, extensor longus digitorum, long extensor of the toes. Origin of term: Latin *extendere* = to stretch out + *digitorum* = pertaining to the digits (toes) + *longus* = long.

Extensor group. A MUSCLE GROUP that extends a particular body part or JOINT, such as the knee or elbow. Extensor groups are located on the upper and lower arm and the upper and lower leg.

Extensor hallucis longus (ek-STEN-sor HAL-loo-sis LON-gus *or* ek-STEN-sor HAL-luc-kiss LON-gus). A MUSCLE positioned between the TIBIALIS ANTERIOR and EXTENSOR DIGITORUM LONGUS muscles on the TIBIA bone of the lower LEG. Only its TENDON shows on the surface. It EXTENDS the great toe (HALLUX), pulling it upward, and also assists in the action of DORSIFLEXION, moving the foot upward at the ANKLE JOINT. Synonyms: musculus extensor hallucis longus (TA), extensor proprius hallucis, EHL, great toe muscle, long extensor of great toe. Origin of term: Latin *extendere* = to stretch out + *hallex* = great toe + *longus* = long.

Extensor pollicis brevis (ek-STEN-sor PAWL-lih-kiss BREV-iss *or* ek-STEN-sor poe-LEE-siss BREH-viss). One of the extrinsic MUSCLES of the THUMB. This deep-layer muscle begins on the ULNA of the FOREARM and inserts on the thumb. It assists in the EXTENSION of the thumb at the CARPO-METACARPAL JOINT and the METACARPO-PHALANGEAL JOINT. Synonyms: musculus extensor pollicis brevis (TA), extensor brevis pollicis, EPB, short extensor of the thumb. Origin of term: Latin *extendere* = to stretch out + *pollicis* = of the thumb + *brevis* = short.

Extensor pollicis longus (ek-STEN-sor PAWL-lih-kiss LON-gus *or* ek-STEN-sor poe-LEE-siss LON-gus). One of the extrinsic MUSCLES of the THUMB. This deep-layer muscle begins on the RADIUS of the FOREARMand inserts on the thumb. It EXTENDS the thumb at the CARPO-METACARPAL JOINT, the METACARPO-PHALANGEAL JOINT, and the INTER-PHALANGEAL JOINT, producing the thumb's up gesture. Synonyms: musculus extensor pollicis longus (TA), extensor longus pollicis, EPL, long extensor of the thumb. Origin of term: Latin *extendere* = to stretch out + *pollicis* = of the thumb + *longus* = long.

Extensor retinaculum of hand (eks-STEN-sor ret-ih-NAK-yoo-lum). A band-like retaining LIGAMENT located at the back of the wrist. It helps holds the EXTENSOR muscle TENDONS in place. Synonym: retinaculum musculorum extensorum (TA). Origin of term: Latin *extendere* = to stretch out + *retinaculum* = a band or halter.

External auditory meatus (mee-AY-tuss). The auditory canal of the ear, commonly called the ear canal. Synonyms: meatus acusticus externus (TA), acoustic meatus, external acoustic meatus. Origin of term: Latin *externus* = on the outside + *audire* = to hear + *meatus* = a passage.

External oblique. A transitional MUSCLE that connects from the RIBCAGE to the PELVIS along the side of the TORSO. It has two portions: the thoracic portion and the abdominal, or flank pad, portion. It assists in the FLEXION of the VERTEBRAL COLUMN, bending the torso frontward at the waist; in LATERAL FLEXION, bending the torso sideways; and in the ROTATION of the torso. Synonyms: musculus obliquus externus abdominis (TA), obliquus externus, obliquus abdominis externus, external abdominal oblique, flank pad muscle. Origin of term: Latin *externus* = on the outside, farther from the center + *obliquus* = slanting.

Extrinsic muscles of the hand. Those muscles of the HAND that originate on the FOREARM and attach into the hand by long TENDONS. Origin of term: Latin *extrinsecus* = from without, from the outside. *Compare* INTRINSIC MUSCLES OF THE HAND

Eye. The entire eye structure, including the EYEBALL, the EYELIDS, tear ducts, optic nerve, and other forms. Synonym: oculus (sing., TA), oculi (pl., TA).

Eyeball. The bulb, or orb, of the EYE, excluding the surrounding eye structures (EYELIDS, tear ducts, optic nerve, etc.). Synonyms: bulbous oculi (TA), orb of eye, bulb of eye, globe of eye.

Eyebrow. The group of hairs forming a curving, ridge-like barrier along the BROW RIDGE. Synonyms: supercilium (sing., TA), supercilia (pl., TA).

Eyelashes. The curling hairs projecting from the edges of the *eyelids*. Synonyms: cilium (sing., TA), cilia (pl., TA).

Eyelid. Either of the two moveable folds of the ORBICULARIS OCULI muscle (the palpebral portion), at the top and bottom of the EYE, that are covered with thin skin and that allow the moistening (through blinking) of the EYEBALL and the closing of the eye. Synonyms: palpebra (TA; pl., palpebrae), blepharon, lid.

Facet. A shallow articulating area on the surface of a BONE. Origin of term: French *facette* = little face.

Facial bones. The fourteen BONES that create the bony scaffolding for the FACIAL MUSCLES. Synonyms: viscerocranium (TA), skeleton of the face, facial skeleton, facie ossea, visceral cranium, cranium viscerale.

Facial muscles. The MUSCLES on the front part of the SKULL that create facial expressions. Synonyms: musculi faciei (TA), muscles of the face, facialis musculature, face muscles.

False ribs. The lower five pairs of RIBS (ribs 8, 9, 10, 11, and 12), which, unlike the so-called TRUE RIBS, do not ATTACH directly into the STERNUM with their own COSTAL CARTILAGE. Ribs 8, 9, and 10 attach to the sternum via a single, shared branch of CARTILAGE, while the lowest two pairs of ribs (ribs 11 and 12) do not attach into the sternum at all. Synonyms: costae spuriae (TA), ribs VIII–XII. *See also* FLOATING RIBS

Fascia (FASH-ee-ah *or* FAY-shee-ah). Thin, fibrous CONNECTIVE TISSUE that surrounds MUSCLES and MUSCLE GROUPS. Origin of term: Latin *fascia* = band, bandage. *See also* DEEP FASCIA, SUPERFICIAL FASCIA

Fascicle (FASS-ih-kul). A group or bundle of MUSCLE FIBERS. Synonym: fasciculus (TA). Origin of term: Latin *fascis* = bundle.

Fatty layer. CONNECTIVE TISSUE composed mainly of fat cells. Synonyms: panniculus adiposus (TA), fatty tissue, adipose tissue. *See also* subcutaneous fat

Femur (FEE-mur). The LONG BONE of the THIGH. Synonyms: os femoris (TA), thigh bone, upper leg bone. Origin of term: Latin *femur* = femur, thigh.

Fibrocartilage (fi-bro-KAR-tih-lij). A type of CARTILAGE forming pads between the VERTEBRAE and between the two PUBIC BONES. Synonyms: fibrocartilago (TA), white cartilage. Origin of term: Latin *fibra* = fiber + *cartilago* = gristle.

Fibrous joint. An IMMOVABLE JOINT or SLIGHTLY MOVABLE JOINT in which the BONES are connected by fibrous CONNECTIVE TISSUE. Synonyms: junctura fibrosa (TA), articulatio fibrosa. Origin of term: Latin *fibra* = fiber.

Fibula (FIB-yoo-lah). The thin, elongated bone located on the LATERAL portion of the lower LEG, next to the TIBIA. Synonyms: calf bone, peroneal bone, splint-bone. Origin of term: Latin *fibula* = a clasp, buckle, brooch

Fixator muscle. *See* STABILIZER MUSCLE

Flat bones. A category of BONES (e.g., the STERNUM) characterized by their thin, flat shape. Synonym: os planum (TA; sing.).

Flex. To bend at a JOINT. Origin of term: Latin *flectere* = to bend.

Flexion (FLEK-shun). The action of flexing, or bending at a JOINT. Synonym: flexio (TA). Origin of term: Latin *flectere* = to bend.

Flexor (FLEK-sor). A MUSCLE that produces the action of bending at a JOINT. Origin of term: Latin *flectere* = to bend.

Flexor carpi radialis (FLEK-sor KAR-pea ray-dee-AL-iss *or* FLEK-sor KARP-eye RAY-dee-ah-liss). A MUSCLE of the ANTERIOR side of the FOREARM that begins on the medial EPICONDYLE OF THE HUMERUS and inserts into the second and third METACARPAL BONES of the HAND. It is a strong FLEXOR of the wrist, bending the hand toward the inner lower arm. It also assists in the ABDUCTION of the hand from the WRIST JOINT (RADIAL ABDUCTION), leaning the hand sideways from the wrist on the RADIAL side of the arm. Synonyms: musculus flexor carpi radialis (TA), musculus radialis internus, FCR, flexor of the wrist on the radial side. Origin of term: Latin *flectere* = to bend + *carpus*, from Greek *karpos* = wrist + Latin *radialis* = pertaining to the radius bone.

Flexor carpi ulnaris (FLEK-sor KAR-pea ull-NAY-riss *or* FLEK-sor KARP-eye ull-NAY-riss). A MUSCLE of the ANTERIOR side of the FOREARM that begins on the medial EPICONDYLE OF THE HUMERUS and inserts into the PISAFORM, the hook of HAMATE and the fifth METACARPAL BONE of the hand. It assists in the FLEXION of the wrist, bending the hand toward the inner arm, and in the ADDUCTION of the hand at the WRIST JOINT (ULNAR ADDUCTION), leaning the hand sideways toward the ULNAR side of the arm. Synonyms: musculus flexor carpi ulnaris (TA), musculus ulnaris internus, FCU, flexor of the wrist on the ulnar side. Origin of term: Latin *flectere* = to bend + *carpus*, from Greek *karpos* = wrist + Latin *ulnaris* = pertaining to the ulna bone.

Flexor digiti minimi brevis (FLEK-sir DIH-jih-tee MIN-ih-mee BREV-iss *or* FLEK-sir DIJ-ih-tie MIN-ih-my BREH-viss). A MUSCLE of the HYPOTHENAR GROUP that FLEXES the LITTLE FINGER, bending it toward the palm. Synonyms: musculus flexor digiti minimi brevis (TA), flexor brevis minimi digiti, flexor digiti quinti brevis, short flexor of the little finger. Origin of term: Latin *flectere* = to bend + *digitus* = digit (finger) + *minimi* = smallest + *brevis* = short.

Flexor digitorum brevis (FLEK-sor dij-ih-TOR-um BREV-iss *or* FLEK-sor dih-jih-TOR-um BREH-viss). A MUSCLE on the PLANTAR SIDE OF THE FOOT that primarily FLEXES the lesser toes at the proximal INTER-PHALANGEAL JOINTS. Synonyms: musculus flexor digitorum brevis pedis (TA), perforatus, flexor brevis digitorum, short flexor of the toes. Origin of term: Latin *flectere* = to bend + *digitorum* = pertaining to the digits (toes) + *brevis* = short.

Flexor group. A MUSCLE GROUP that FLEXES a particular body part or JOINT, such as the THIGH or ELBOW JOINT. Flexor groups are located on the upper and lower ARM and the upper and lower LEG.

Flexor pollicis brevis (FLEK-sor poe-LEE-siss BREV-iss *or* FLEK-sor PAWL-lih-kiss BREH-viss). One of the MUSCLES of the THENAR GROUP. It FLEXES the THUMB, moving it back to the palm (or across the palm) from an extended position. Synonyms: musculus flexor pollicis brevis (TA), flexor brevis pollicis, short flexor of thumb, FPB. Origin of term: Latin *flectere* = to bend + *pollicis* = of the thumb + *brevis* = short.

Flexor retinaculum of hand (FLEK-sor ret-ih-NAK-yoo-lum). A fibrous band that connects to the four CARPAL BONES of the PALMAR SIDE OF THE HAND, forming a tunnel (the CARPAL TUNNEL) on the carpal arch, through which the long flexor TENDONS of the FOREARM pass to ATTACH into the fingers. Synonyms: retinaculum musculorum flexorum (TA), transverse carpal ligament. Origin of term: Latin *flectere* = to bend + *retinaculum* = a band or halter.

Floating ribs. The lower two pairs of RIBS (ribs 11 and 12), which do not ATTACH into the STERNUM by way of COSTAL CARTILAGE. Synonyms: costae fluctuantes (TA), ribs XI–XII, vertebral ribs. *Compare* FALSE RIBS, TRUE RIBS

Foot pads. Fatty tissue pads on the sole of the foot (PLANTAR SIDE OF THE FOOT), including the pads on the heel, the ball of the foot, the LATERAL side of the foot, and the tips and bottom portions of the toes.

Foramen (foh-RAY-men). A round or oval aperture in a BONE. Origin of term: Latin *forare* = to pierce.

Forearm. The part of the arm between the ELBOW and wrist. Synonyms: antebrachium (TA), lower arm, ulna and radius bones.

Fossa (on bone) (FOSS-ah). A shallow, basin-like depression in a BONE. Origin of term: Latin *fossa* = ditch, trench.

Fossa (on skin) (FOSS-ah). A shallow depression on the skin (e.g., the CUBITAL FOSSA). Origin of term: Latin *fossa* = ditch, trench.

Free edge of a fingernail. The outer edge of a fingernail at its tip, which is usually lighter in color than the rest of the nail, signifying new growth. Synonyms: margo liber (TA), free margin, free border.

Freely movable joint. A JOINT that is capable of many degrees of movement; a SYNOVIAL JOINT. Synonym: diarthrosis (TA). *See also* BALL-AND-SOCKET JOINT, CONDYLOID JOINT, ELLIPSOID JOINT, GLIDING JOINT, HINGE JOINT, PIVOT JOINT, PLANE JOINT, SADDLE JOINT

Frontal bone. The CRANIAL BONE of the forehead region. Synonyms: os frontale (TA), forehead. Origin of term: Latin *frons* or *frontis* = forehead, brow.

Frontalis (frun-TAY-liss *or* frun-TAL-liss). The MUSCLE of the forehead located on the FRONTAL BONE of the CRANIUM. The frontalis can contract in three different ways: to lift both eyebrows, to lift only one eyebrow, and to lift the inner ends of the eyebrows. Synonyms: musculus occipitofrontalis (TA), venter frontalis (TA), occipitofrontalis, epicranius muscle, frontal belly, muscle of forehead. Origin of term: Latin *frons* or *frontis* = forehead, brow.

Fusiform muscle fibers (FYOO-sih-form). Muscle fiber arrangement in which PARALLEL MUSCLE FIBERS bulge at their centers (producing a muscle BELLY) and taper toward each end. Synonym: musculus fusiformis (TA). Origin of term: *fusus* = a spindle + *forma* = shape.

Gastrocnemius (gas-trock-NEE-mee-us). The calf MUSCLE, positioned on the POSTERIOR side of the lower LEG. It has two HEADS: the outer (or lateral) head and the inner (or medial) head. It assists in the FLEXION of the lower leg (TIBIA) at the KNEE JOINT, in the PLANTAR FLEXION of the foot, and in raising the heel from the ground in the action of standing on tiptoe. Synonyms: musculus gastrocnemius (TA), calf muscle, calf. Origin of term: Greek *gaster* = belly + *kneme* = leg, shank, shinbone.

Gingiva (JIN-jih-vah). The gums surrounding the bases of the TEETH. They are composed of dense fibrous tissue covered by a mucous membrane. Synonym: periodontium protectionis (TA). Origin of term: Latin *gingiva* = gum.

Glabella (gluh-BELL-ah). A smooth PROMINENCE above the ROOT OF THE NOSE on the FRONTAL BONE. Synonyms: intercilium, mesophryon. Origin of term: Latin *glaber* = without hair.

Glenoid fossa (GLEN-oyd FOSS-ah *or* GLEE-noyd FOSS-ah). The shallow, pear-shaped socket on the LATERAL side of the SCAPULA. It forms part of the BALL-AND-SOCKET JOINT of the shoulder. Synonyms: cavitas glenoidalis (TA), glenoid cavity. Origin of term: Greek *glenoeides*, from *glene* = socket of joint + *eidos* = resemblance + Latin *fossa* = ditch, trench.

Gliding joint. A JOINT in which two BONES with flat or slightly curved surfaces glide across each other. Synonyms: articulatio plana (TA), plane joint, arthrodia, arthrodial joint.

Gluteal cleft (GLOO-tee-ul). The vertical division between the two GLUTEUS MAXIMUS muscles. Synonyms: crena intergluteralis (TA), crena analis (TA), crena ani (TA), natal cleft, intergluteal cleft, vertical cleft of gluteus, vertical cleft of buttocks. Origin of term: Greek *gloutos* = buttock.

Gluteal fold (GLOO-tee-ul). A prominent horizontal skin fold at the lower part of the GLUTEUS MAXIMUS. Synonyms: sulcus glutealis (TA), gluteal sulcus, gluteal furrow, transverse furrow of buttock, fold of nates, natal fold. Origin of term: Greek *gloutos* = buttock.

Gluteal group (GLOO-tee-ul). A MUSCLE GROUP of the THIGH, attaching on the PELVIS, that includes the GLUTEUS MAXIMUS, GLUTEUS MEDIUS, GLUTEUS MINIMUS, and TENSOR FASCIA LATAE. Synonyms: regio glutealis (TA), gluteal region, gluteus group, glutes, buttocks. Origin of term: Greek *gloutos* = buttock.

Gluteus maximus (GLOO-tee-us MACK-sih-muss). The largest MUSCLE of the GLUTEAL GROUP. It moves the THIGH backward (EXTENSION of the thigh) and assists in rotating the upper leg outward (LATERAL ROTATION of the thigh). It also acts as a lateral STABILIZER of the HIP JOINT and KNEE JOINT and assists in maintaining an upright posture. Synonyms: musculus gluteus maximus (TA), large buttock muscle. Origin of term: Greek *gloutos* = buttock + Latin *maximus* = greatest.

Gluteus medius (GLOO-tee-us MEE-dee-us). The MUSCLE located in the middle of the GLUTEAL GROUP. It helps move the THIGH sideways, away from the BODY (ABDUCTION of the thigh), and assists in the MEDIAL ROTATION of the thigh. Synonyms: musculus gluteus medius (TA), middle buttock muscle. Origin of term: Greek *gloutos* = buttock + Latin *medius* = middle.

Gomphosis joint (gom-FOH-siss). A fibrous IMMOVABLE JOINT in which a peg-like structure (e.g., a TOOTH) fits into a socket. Synonyms: syndesmosis dentoalveolaris (TA), dento-alveolar syndesmosis, socket. Origin of term: Greek *gomphosis* = a nailing together.

Gracilis (GRAHS-ih-liss *or* GRAH-suh-liss *or* GRISS-sih-liss *or* grah-SIL-iss). The slender MUSCLE along the MEDIAL side of the inner thigh group (ADDUCTOR GROUP). It assists in the adduction of the thigh at the hip joint. Synonym: musculus gracilis (TA). Origin of term: Latin *gracilis* = slender.

Greater trochanter (troh-KAN-ter). A large, prominent PROCESS at the upper part of the FEMUR on the LATERAL side. Synonym: trochanter major (TA). *See also* TROCHANTER

Greater tubercle (TOO-ber-kel). A large angular bony projection (TUBERCLE) near the HEAD OF THE HUMERUS. Synonyms: tuberculum majus (TA), greater tuberosity, major tubercle.

Ground substance. A gel-like substance that is part of the MATRIX of CONNECTIVE TISSUE. Fibers of different types (e.g., collagen, elastic fibers) are embedded in the ground substance. The matrix also contains a variety of individual connective-tissue cells (e.g., fat cells, bone cells).

Hallux (HAL-uks). The first DIGIT of the foot (the great toe). Synonyms: digiti primus (TA), great toe, big toe, large toe, first toe. Origin of term: Latin *hallex* = great toe.

Hamate carpal bone (HAM-ate). A hook-shaped bone located in the DISTAL ROW OF CARPAL BONES, in the wrist region. Synonyms: os hamatum (TA), hamulus, unciform bone, hamatum. Origin of term: Latin *hamulus* = little hook.

Hamstring group. The common name for the MUSCLE GROUP positioned on the back (posterior COMPARTMENT) of the THIGH. Synonyms: compartimentum femoris posterius (TA), compartimentum femoris flexorum (TA), hamstring muscles, posterior femoral region, posterior thigh muscles, muscles of the posterior aspect of the thigh, posterior compartment of the thigh, muscles of the back of the thigh, flexor compartment of the thigh.

Hand. The whole hand, including the wrist, palm, DORSUM of the hand, fingers, and THUMB. Synonym: manus (TA).

Head (of bone). The expanded end of a LONG BONE, sometimes having a round shape. Synonym: caput (TA).

Head (of muscle). Any of the ORIGINS of a MUSCLE having more than one origin (e.g., the two-headed BICEPS BRACHII). Synonym: caput (TA).

Head of the femur. The golf-ball-shaped feature at the top of the FEMUR bone of the THIGH. It articulates with the PELVIS at the ACETABULUM, creating the BALL-AND-SOCKET JOINT of the hip (HIP JOINT). Synonym: caput femoris (TA).

Head of the fibula. The expanded PROXIMAL end of the FIBULA bone, located on the lower LEG near the outer region of the KNEE JOINT. Synonyms: caput fibulae (TA), capitulum fibulae.

Head of the humerus. The spherically shaped PROXIMAL end of the HUMERUS bone, which ARTICULATES with the SCAPULA to create the BALL-AND-SOCKET JOINT of the shoulder (SHOULDER JOINT). Synonym: caput humeri (TA).

Head of the radius. The small, disk-shaped feature at the upper end of the RADIUS bone, which ARTICULATES with the CAPITULUM on the lower end of the HUMERUS to produce the ROTATION of the FOREARM. Synonyms: caput radii (TA), capitulum radii.

Head of the ulna. The small, bump-like projection at the DISTAL end of the ULNA bone, near the wrist region. Synonyms: caput ulnae (TA), capitulum ulnae.

Helix. The tubular outer rim of the ear. Origin of term: Greek *helix* = coil.

Hinge joint. A JOINT in which convex surface on one BONE fits into a concave surface on another bone. Synonyms: ginglymus (TA), ginglymoid joint.

Hip bone. One whole side of the pelvic structure, comprising the ILIUM, ISCHIUM, and PUBIS. Synonyms: os coxae (TA), innominate bone, os innominatum, pelvis bone, pelvic bone, haunch bone, coxal bone, coxa.

Hip joint. The BALL-AND-SOCKET JOINT created by the ACETABULUM of the PELVIS and the HEAD OF THE FEMUR. Synonyms: articulatio coxae (TA), articulatio coxofemoralis (TA), joint of hipbone.

Humerus (HYOO-murr-us). The BONE of the upper ARM. Synonyms: upper arm bone, os brachii. Origin of term: Latin *humerus* = shoulder.

Hyaline cartilage (HI-ah-lin KAR-tah-lij). A type of CARTILAGE found throughout the body in many forms. It is on the articulating surfaces of BONES at JOINTS, where it reduces friction. It also forms the COSTAL CARTILAGES of the RIBCAGE, as well as the cartilages of the LARYNX, the TRACHEA, and parts of the NOSE. Origin of term: Greek: *hyalos* = glass.

Hyperextension. Movement in which a body part (e.g., an ARM) is extended beyond the normal limit or ANATOMICAL POSITION. Origin of term: Greek *hyper* = above, over + Latin *extendere* = to stretch out.

Hyoid bone (HI-oyd). A horseshoe- or U-shaped BONE positioned between the MANDIBLE and LARYNX. Synonyms: os hyoideum (TA), lingual bone, tongue bone, os hyale. Origin of term: Greek *hyoeides* = shaped like an upsilon (the twentieth letter of the Greek alphabet).

Hypothenar group (hi-POTH-ih-nar). The MUSCLE GROUP on the MEDIAL side of the palm (the LITTLE FINGER side), which together create an elongated teardrop shape on the surface form. Synonyms: eminentia hypothenaris (TA), hypothenar, hypothenar eminence, antithenar eminence. Origin of term: *hypo* = under + *thenar* = palm.

Iliac crest (ILL-ee-ak). The curved upper border of the PELVIS bone. Synonyms: crista iliaca (TA), crest of the iliac, crest of the ilium. Origin of term: Latin *ilium* = groin, flank + *crista* = a comb or tuft on the head of a bird.

Ilio-tibial tract (ILL-ee-oh-TIB-ee-ul). A FASCIA strap that begins with the GLUTEAL GROUP of muscles of the PELVIS, near the GREATER TROCHANTER of the FEMUR, and inserts into the lateral CONDYLE of the TIBIA. Synonyms: tractus iliotibialis (TA), ilio-tibial band, ITB. Origin of term: Latin *ilium* = groin, flank + *tibia* = shinbone.

Ilium (ILL-ee-um). The large, wing-like part of the PELVIS. Synonyms: os ilium (TA), iliac bone, flank bone. Origin of term: Latin *ilium* = groin, flank.

Immovable joint. A JOINT that permits no movement. Immovable joints include the SUTURE JOINTS of the SKULL. Synonym: synarthrosis (TA).

Incisor. Any of the eight TEETH (four at the center of each DENTAL ARCH) that have a flat, chisel-shaped crown. Synonym: dens incisivus (TA). Origin of term: Latin *incidere* = to cut into.

Index finger. The second DIGIT of the HAND. Synonyms: indicis, digitus secundus (TA), forefinger, II digit.

Inferior. Direction/location term meaning "situated below" or "directed downward"; opposite of SUPERIOR. Origin of term: Latin *infra* = below, under.

Inferior angle of the scapula. The lower tip of the SCAPULA bone (shoulder blade). Synonym: angulus inferior (TA).

Inferior extensor retinaculum of foot (in-FEAR-ee-or ek-STEN-sor ret-ih-NAK-yoo-lum). A Y-shaped LIGAMENT that serves as a restraining band for the extensor TENDONS of the lower LEG, which ATTACH into the foot below the ANKLE JOINT. Synonyms: retinaculum musculorum extensor inferius (TA), retinaculum musculorum, cruciate ligament, ligament cruciatum cruris. Origin of term: Latin *infra* = below, under + *extendere* = to stretch out + *retinaculum* = a band or halter.

Inferior nasal concha (in-FEAR-ee-or NAY-zul KON-kah) Either of a pair of scroll-like BONES (pl., conchae) that form part of the LATERAL walls of the NASAL CAVITY in the SKULL.

Synonyms: concha nasalis inferior (TA), os maxilloturbinal, inferior turbinate. Origin of term: Latin *infra* below, under + *nasus* = nose + *concha* = shell.

Infraclavicular fossa (IN-fra-klah-VICK-yoo-lar FOSS-ah). A small triangular depression in the skin occurring between the DELTOID and PECTORALIS MAJOR muscles below the CLAVICLE bone. Synonyms: fossa infraclavicularis (TA), trigonum deltopectorale (TA), trigonum clavipectorale (TA), Mohrenheim's fossa, Mohrenheim's triangle, deltopectoral triangle, clavipectoral triangle. Origin of term: Latin *infra* = below, under + *clavicula* = a small key + *fossa* = ditch, trench.

Infraglenoid tubercle (in-fra-GLEN-oyd TOO-ber-kel). A triangular roughened area on the SCAPULA bone, slightly below the GLENOID FOSSA. It is the ATTACHMENT site of the long HEAD of the TRICEPS BRACHII. Synonyms: tuberculum infraglenoidale (TA), infraglenoid tuberosity of the scapula, tuberositas infraglenoidalis. Origin of term: Latin *infra* = below, under + Greek *glenoeides,* from *glene* = socket of joint + *eidos* = resemblance + Latin *tuberculum* = a swelling or knob.

Infraspinatus (IN-frah-spih-NAH-tuss *or* in-frah-spy-NAY-tuss). The MUSCLE of the TORSO that ATTACHES on most of the ANTERIOR surface of the SCAPULA. It assists in the LATERAL ROTATION of the upper ARM, rotating it outward. Synonym: musculus infraspinatus (TA). Origin of term: Latin *infra* = below, underneath + *spina* = thorn, spine.

Infraspinous fossa (in-fra-SPY-nuss FOSS-ah). A large valley-shaped depression on the SCAPULA bone, located below the SPINE OF THE SCAPULA, that serves as the ATTACHMENT site for the INFRASPINATUS muscle. Synonym: fossa infraspinata (TA). Origin of term: Latin *infra* = below, underneath + *spina* = thorn, spine + *fossa* + ditch, trench.

Inguinal ligament (ING-gwih-nul LIG-uh-ment). A fibrous band connecting from the ANTERIOR SUPERIOR ILIAC SPINE of the PELVIS to the PUBIC BONE. It is the thickened lower border of the APONEUROSIS OF THE EXTERNAL OBLIQUE muscle. Synonyms: ligamentum inguinale (TA), arcus inguinalis (TA), Poupart's ligament, fold of the groin, crural arch. Origin of term: Latin *inguen* = groin.

Inner angle of the eye. The inside corner of the EYE, near the NOSE structure. Synonyms: angulus oculu medialis (TA), commissura medialis palpebrarum (TA), internal canthus, inner canthus, medial palpebral commissure, medial angle of eye.

Insertion of a muscle. The point of ATTACHMENT of a MUSCLE on a BONE from which the bone moves when the muscle contracts. In medical charts and anatomical SKELETONS, insertion points are traditionally indicated in blue. Synonyms: punctum mobile (TA), tendon of insertion, distal insertion, more movable part of skeleton, more movable point of attachment, mobile end. *Compare* ORIGIN

Intermuscular septum (SEP-tum). A sheet of APONEUROSIS that separates one MUSCLE GROUP from another. Synonym: septum musculare (TA). Origin of term: Latin *septum* = partition.

Interosseus membrane (IN-ter-OSS-ee-us). A fibrous CONNECTIVE TISSUE between BONES. Interosseous membranes occur between the RADIUS and ULNA of the FOREARM and between the TIBIA and FIBULA of the lower LEG. Synonyms: interosseous membrane of forearm: membrana interossea antibrachii (TA); interosseous membrane of leg: membrana interossea cruris (TA). Origin of term: Latin *interosseous* = between the bones.

Inter-phalangeal joint, or **IP joint** (in-ter-fah-LAN-gee-ul). A joint between two PHALANX bones in a finger, THUMB, or toe. Synonyms: articulationes interphalangeae (TA); inter-phalangeal joints of hand: articulationes interphalangeae manus (TA), articulationes digitorum manus; inter-phalangeal joints of foot: articulationes interphalangeae pedis (TA). Origin of term: Latin *inter* = between + Greek *phalanx* = line or flank of soldiers. *See also* DISTAL INTER-PHALANGEAL JOINT, PROXIMAL INTER-PHALANGEAL JOINT

Intertubercular groove (in-ter-too-BUR-kyoo-lar *or* in-ter-too-BURK-yoo-lar). A trench-like groove on the upper part of the HUMERUS bone between the GREATER TUBERCLE and LESSER TUBERCLE. It has a slight ridge on the outer side called the lateral lip. Synonyms: sulcus intertubercularis (TA), intertubercular sulcus, bicipital grove, sulcus bicipitalis. Origin of term: Latin *inter* = between + *tuberculum* = a swelling or knob.

Intervertebral disc (IN-ter-VUR-teh-bral). Any of the fibrous CARTILAGE discs, or pads, that are positioned between the VERTEBRAE and serve as shock absorbers. Synonyms: discus intervertebralis (TA), fibrocartilago intervertebralis, intervertebral fibrocartilage. Origin of term: Latin *inter* = between+ *vertebra,* from *verto* = turn.

Intrinsic muscles of the hand. MUSCLES in which both the ORIGINS and INSERTIONS are located in the region of the HAND, as opposed to the EXTRINSIC MUSCLES OF THE HAND, whose insertions are in the hand but whose origins are located in the FOREARM.

Inversion. Movement of the foot in which the PLANTAR SIDE OF THE FOOT is turned inward, or medially, toward the MEDIAL LINE (CENTRAL AXIS) of the BODY. Origin of term: Latin *invertere* = to turn about, to turn over.

Iris. The colored disk of the EYE, in which is embedded a ring of small MUSCLE FIBERS surrounding a central opening (the PUPIL). Origin of term: Greek *iris* = rainbow.

Irregular bones. A category of BONES (e.g., the VERTEBRAE, the individual bones of the SKULL) characterized by their complex forms. Synonyms: os irregulare (TA; sing.), mixed bones.

Ischial tuberosity (ISS-kee-ul TOO-ber-OSS-ih-tee *or* ISS-kee-ul TOO-ber-ROSS-ih-tee). A rough-textured projection located on the lower part of the ISCHIUM of the PELVIS. Synonyms: tuber ischiadicum (TA), ischial tuberosities, tuberosity of ischium, tuber ischii. Origin of term: Greek *ischion* = hip joint + Latin *turberosus* = full of bumps.

Ischium (ISS-kee-um). The lower portion of the PELVIS, consisting of a BODY and a RAMUS. Synonyms: os ischii (TA), ischial bone, sits bone, sitz bone, seated bones. Origin of term: Greek *ischion* = hip joint.

Joint. A connection of one BONE with another bone. Joints are classified into three basic types: CARTILAGINOUS JOINTS, FIBROUS JOINTS, and SYNOVIAL JOINTS. Synonyms: junctura (TA), articulation. *See also* AMPHIARTHROSIS, ANKLE JOINT, BALL-AND-SOCKET JOINT, BIAXIAL JOINT, CARPO-METACARPAL JOINT, CONDYLOID JOINT, DIARTHROSIS, DISTAL INTER-PHALANGEAL JOINT, ELBOW JOINT, ELLIPSOID JOINT, FREELY MOVABLE JOINT, GLIDING JOINT, GOMPHOSIS JOINT, HINGE JOINT, HIP JOINT, IMMOVABLE JOINT, INTER-PHALANGEAL JOINT, KNEE JOINT, METACARPO-PHALANGEAL JOINT, MULTIAXIAL JOINT, PIVOT JOINT, PLANE JOINT, PROXIMAL INTER-PHALANGEAL JOINT, PUBIC SYMPHYSIS, SADDLE JOINT, SHOULDER JOINT, SLIGHTLY MOVABLE JOINT, SUTURE JOINT, SYNARTHROSIS, SYNCHRONDOSIS, SYNDESMOSIS, TEMPORO-MANDIBULAR JOINT, UNIAXIAL JOINT, WRIST JOINT

Joint capsule. A sac-like, fibrous envelope surrounding a SYNOVIAL JOINT, formed by LIGAMENTS on the outside and containing a SYNOVIAL MEMBRANE on the inside. Synonyms: capsula articularis (TA), articular capsule, fibrous articular capsule, synovial capsule.

Joints of the hand. *See* CARPO-METACARPAL JOINT, DISTAL INTER-PHALANGEAL JOINT, INTER-PHALANGEAL JOINT, METACARPO-PHALANGEAL JOINT, PROXIMAL INTER-PHALANGEAL JOINT

Keratin (KER-a-tin). The fibrous, protein-based material composing the hair and nails. Synonym: cytokeratin. Origin of term: Greek *keras, keratos* = horn.

Kinesiology (kin-easy-ology *or* KEN-ee-see-ALL-ah-jee *or* keh-NEE-see-OL-ah-jee). The study of MUSCLES, BONES, and other structures in movement. Origin of term: Greek *kinesis* = movement + *logos,* from *legein* = to speak.

Kneecap. *See* PATELLA

Knee joint. The SYNOVIAL JOINT between the CONDYLES OF THE FEMUR and the CONDYLES of the TIBIA as well as between the FEMUR and the kneecap (PATELLA). Synonyms: articulatio genus (TA), femoropatellar joint, patellofemoral joint, tibiofemoral joint.

Lacrimal bone (LACK-rih-mal). Either of two IRREGULAR BONES that form part of the inside walls of the eye sockets (ORBITS). Synonyms: os lacrimale (TA), os unguis. Origin of term: Latin *lacrima* = a tear.

Lacrimal caruncle (LACK-rih-mal KAR-ungk-el *or* LACK-rih-mal car-RUNG-kul *or* LACK-rih-mal CARE-un-kul). The small, pinkish, fleshy mass at the inside corner of the EYE. Synonym: caruncula lacrimalis (TA). Origin of term: Latin *lacrimare* = to weep + *carincula* = small fleshy mass.

Laryngeal prominence (la-RIN-jee-al *or* lar-in-JEEL). A small projection on the front of the THYROID CARTILAGE in the neck. Commonly called the Adam's apple, it is usually more prominent in males than in females. Synonym: prominentia laryngea (TA). Origin of term: Greek *laryngos* = larynx + Latin *prominentia* = a projection.

Larynx (LAIR-ingks *or* LAR-inks). A framework of CARTILAGE, MUSCLES, and elastic membranes in the throat that makes up the voice box and upper portion of the windpipe. Synonym: voice box. Origin of term: Greek *laryngos* = larynx.

Lateral. A direction/location term meaning "farther away from the MEDIAL LINE"; opposite of MEDIAL. Origin of term: Latin *lateralis* = of the side.

Lateral cartilages of the nose. CARTILAGES forming the side structures of the NOSE. Synonym: lateral nasal cartilage.

Lateral flexion. Movement of the VERTEBRAL COLUMN (TRUNK or head) that bends it to one side. Synonyms: lateral inclination, lateral tilt, side bending. Origin of term: Latin *lateralis* = of the side + *flectere* = to bend.

Lateral longitudinal arch of foot. An inconspicuous low arch located along the outer length of the foot. Synonyms: arcus pedis longitudinalis—pars lateralis (TA), arcus pedis lateralis, longitudinal arch of foot—lateral part. Origin of term: Latin *lateralis* = of the side + French *longitude,* from Latin *longitudo* = running lengthwise.

Lateral malleolus (mal-LEE-oh-luss *or* mal-LAY-oh-luss). The outer ankle of the lower LEG, located on the lower end of the FIBULA. Synonyms: malleolus lateralis (TA), outer ankle, malleolus fibulae, external malleolus. Origin of term: Latin *lateralis* = of the side + *malleolus* = a little hammer or mallet.

Lateral rotation. ROTATION away from the MEDIAL LINE (CENTRAL AXIS) of the BODY. Synonyms: rotatio externa (TA), exorotatio (TA), rotatio lateralis (TA), external rotation, outward rotation. Origin of term: Latin *lateralis* = of the side + *rotare* = to revolve.

Latissimus dorsi (lah-TISS-ih-muss DOR-see *or* lah-TISS-ih-muss DOR-sigh). The large V-shaped MUSCLE of the back. It ADDUCTS the ARM, pulling a vertically or horizontally positioned arm back to the side of the TORSO; assists in the EXTENSION of the arm, returning a flexed arm positioned in front of the torso back to the side of the torso; and plays a role in the MEDIAL ROTATION of the arm, rotating the arm inward. Synonyms: musculus latissimus dorsi (TA), "swimmer's muscle," "dress-coat pocket muscle," "lats." Origin of term: Latin *latissimus* = widest, broadest + *dorsum* = back.

Leg. In anatomical usage, the lower portion of the whole leg, from the knee to the ankle. In ANATOMY, the upper leg is referred to as the THIGH. In common usage, the word *leg* refers to the whole LOWER LIMB. Synonyms: lower leg, tibia bone (with fibula), cnemis.

Lesser supraclavicular fossa (SOO-prah-klah-VICK-yoo-lar FOSS-ah). An extremely small triangular depression in the skin between the TENDONS of the sternal and clavicular HEADS of the STERNOCLEIDOMASTOID muscle, at their point of ORIGIN on the sternum and CLAVICLE bones. Synonyms: fossa supraclavicularis minor (TA). Origin of term: Latin *supra* = above + *clavicula* = a little key + *fossa* = ditch, trench.

Lesser trochanter of the femur. A small bony protrusion (TROCHANTER) on the FEMUR, near the MEDIAL side, that serves as an ATTACHMENT site for MUSCLES. Synonyms: small trochanter, trochanter minor.

Lesser tubercle of the humerus. A small projection (TUBERCLE) near the HEAD OF THE HUMERUS. Synonyms: tuberculum minus (TA), lesser tuberosity, minor tubercle.

Levator (ley-VAY-tor *or* LEV-uh-tor *or* leh-VAH-tor). A MUSCLE that moves a structure upward. Origin of term: Latin *levator* = a raiser or lifter.

Levator labii superioris (LEV-uh-tor LAY-bee-eye soo-PEER-ee-OR-iss *or* leh-VAH-tor lay-bee-eye soo-PEER-ee-or-iss). A MUSCLE that ATTACHES from the ORBICULARIS OCULI muscle to the ORBICULARIS ORIS muscle and that elevates the upper LIP. Synonyms: musculus levator labii superioris (TA), infraorbital head of the quadratus labii superioris muscle group, lateral head of the levator labii superioris, levator labii superioris proprius, caput infraorbitale quadrati labii superioris. Origin of term: Latin *levator* = a raiser or lifter + *labium* = lip + *superioris* = above.

Levator labii superioris alaeque nasi (LEV-uh-tor LAY-bee-eye soo-PEER-ee-OR-iss uh-lee-kwee NAY-zee *or* leh-VAH-tor LAB-ee-eye soo-PEER-ee-or-iss uh-LEE- qwee NAYZ-eye). A small, slender MUSCLE that passes along the side of the NOSE and that elevates the upper LIP and the WING OF THE NOSE. Synonyms: musculus levator labii superioris alaeque nasi (TA), levator alae nasi, levator labii superioris et alae nasi, angular head [caput angular] of the quadratus labii superioris, nasal portion of the levator labii superioris muscle. Origin of term: Latin *levator* = a raiser or lifter + *labium* = lip + *superioris* = above + *ala* = wing + *que* = and + *nasi* = nose.

Ligament (LIG-uh-ment). A band-like CONNECTIVE TISSUE that connects BONES to each other at or near JOINTS. Synonym: ligamenta (TA). Origin of term: Latin *ligamentum* = band, bandage. *See also* INGUINAL LIGAMENT, NUCHAL LIGAMENT, PATELLAR LIGAMENT

Linea alba (LIN-ee-ah AL-bah). A fibrous band of CONNECTIVE TISSUE that ATTACHES from below the STERNUM of the RIBCAGE to the PUBIC BONE in a vertical alignment along the ABDOMEN. It receives the ATTACHMENTS of the abdominal MUSCLES. Synonym: white line. Origin of term: Latin *linea* = line + *alba* = white.

Linea aspera (LIN-ee-ah AHS-per-ah). A rough-textured ridge that runs most of the length of the FEMUR on the POSTERIOR side. Synonym: crista femoris. Origin of term: Latin *linea* = line + *aspera* = rough.

Line of action. An imaginary directional line that moves through the center of the entire figure as well as through a body part (e.g., torso, leg, *or* ARM), thus indicating the alignment or angle in a pose. Synonym: central axis.

Lips. The two muscular folds of the ORBICULARIS ORIS muscle. Synonyms: labia (TA; pl.), labium (TA, sing.), labia oris, vermilion portions (or zone), red margins of the lips, red lip portions, transitional zone of the lips; upper lip: labium superius (TA); lower lip: labium inferius (TA), labium mandibulare.

Little finger. The smallest DIGIT of the HAND. Synonyms: digitus minimus (TA), digitus quintus (TA), fifth finger, V digit, pinky.

Lobe of the ear. The fleshy mound occurring at the end of the outer rim of ear (HELIX) as it attaches into the skin near the TEMPOROMANDIBULAR JOINT and the MASTOID PROCESS. Synonyms: lobulus auriculae (TA), lobule of auricle, earlobe, lobule, lobus. Origin of term: Greek *lobos* = lobe of ear.

Long bones. A category of BONES (e.g., the FEMUR, the HUMERUS) characterized by a cylindrical shaft with two ends that are generally wider than the shaft. Synonym: os longum (TA).

Lower leg. *See* leg

Lower limb. The hip, THIGH, lower LEG, ankle, and foot, considered as a unit. Synonym: lower extremity.

Lumbar vertebrae (LUM-bar VER-teh-bree *or* LUM-bar VER-teh-bray). Five large VERTEBRAE located between the RIBCAGE and PELVIS. Synonyms: vertebrae lumbales (TA), small of the back, LI–LV, L1–L5. Origin of term: Latin *lumbus* = loin + *vertebra,* from *verto* = turn.

Lunate carpal bone (LOO-nate). The crescent-shaped CARPAL BONE in the PROXIMAL ROW of the wrist region. Synonyms: os lunatum (TA), semilunar bone, os semilunare. Origin of term: Latin *luna* = moon.

Lunula (LOO-nyoo-lah *or* LOON-yoo-lah *or* LOO-nyul). A light-colored half-moon shape at the base of the fingernail, thumbnail, or nail of the great toe. Synonym: lunule of nail. Origin of term: Latin *lunula* = crescent, little moon, diminutive of *luna* = moon.

Major alar cartilage of nose (MA-jur AY-lar KAR-tah-lij). The CARTILAGE of the NOSE that forms the TIP OF THE NOSE, or ball of the nose. Synonyms: cartilagio alaris major (TA), greater alar cartilage, cartilagines alares majores. Origin of term: Latin *ala* = wing + *cartilago* = gristle.

Malleolus. *See* LATERAL MALLEOLUS, MEDIAL MALLEOLUS

Mandible (MAN-dih-bul). The horseshoe-shaped BONE of the lower jaw. Synonyms: mandibula (TA), lower jaw bone, submaxilla, submaxillary bone, inferior maxillary bone, inframaxillary bone. Origin of term: Latin *mandibula* = lower jawbone.

Manikin (MAN-eh-kin). A blocklike preliminary underdrawing of a figure that establishes the general proportions and basic pose before the details of the forms are added. (The term can also refer to an artist's three-dimensional model of the figure, with movable parts.) Synonyms: structure of the figure, armature of pose, construction of pose, preliminary drawing of pose, underlying drawing, blocking in of pose, laying in of pose. Origin of term: French *mannequin,* from Dutch *manneken* = a figure or model of the human body.

Manubrium (maa-NEW-bree-um). The upper portion of the STERNUM. Synonyms: manubrium sterni (TA), manubrium of sternum, presternum. Origin of term: Latin *manubrium* = handle.

Masseter (MASS-ee-tur *or* maa-SEE-tur). A MUSCLE located on the side of the lower jaw. It helps elevate the MANDIBLE in the action of closing an opened mouth with a dropped jaw. Synonyms: musculus masseter (TA), chew muscle. Origin of term: Greek *maseter* = masticator, chewer.

Mastoid process (MASS-toyd). A bumplike protrusion (PROCESS) on the SKULL, behind the EXTERNAL AUDITORY MEATUS, that serves as an ATTACHMENT site for MUSCLES. Synonyms: processus mastoideus (TA), processus mastoidei, mastoid bone, os mastoideum. Origin of term: Greek *mastoid* = breastlike.

Matrix (MAY-trix). The extracellular substance of CONNECTIVE TISSUES. It consists of a GROUND SUBSTANCE in which particular fibers (e.g., collagen, elastic fibers) are embedded. Each type of connective tissue (e.g., BONE, CARTILAGE, LIGAMENT, TENDON) has its own unique extracellular matrix, differing from the others in the proportions of the components and the type of fibers and connective-tissue cells involved. Origin of term: Latin *matrix* = womb, source, origin.

Maxilla bones (mack-SIH-luh *or* max-ILL-la *or* MACK-sil-ah *or* MACK-zil-lah). Two joined BONES of the SKULL that together form the upper DENTAL ARCH and parts of the lower ORBITS (eye sockets), NASAL CAVITY, and hard PALATE. Synonyms: upper jawbone, superior maxillary bone. Origin of term: Latin *maxilla* = upper jawbone.

Medial (MEE-dee-ul *or* MEED-ee-ul). A direction/location term indicating nearness to or movement toward the MEDIAL LINE (CENTRAL AXIS) of the BODY or the medial line of a body part. Origin of term: Latin MEDIALIS = of the middle.

Medial border of the scapula. The border of the shoulder blade (SCAPULA) that is closer to the VERTEBRAL COLUMN. Synonyms: margo medialis (TA), margo vertebralis, internal border, vertebral border.

Medial line. An imaginary line defining the CENTRAL AXIS of the BODY, dividing the figure vertically into equal right and left halves; also, an imaginary line defining the central axis of a body part, such as an ARM or LEG. Synonyms: central axis of figure, midline of body, midsagittal plane.

Medial longitudinal arch. The highest arch of the foot, running lengthwise along the inside region of the foot. Synonyms: arcus pedis longitudinalis—pars medialis (TA), arcus pedis medialis, longitudinal arch of foot—medial part.

Medial malleolus (MEE-dee-ul mal-LAY-oh-luss *or* MEE-dee-ul mal-LEE-oh-luss). The inner ankle of the lower LEG, located at the lower end of the TIBIA. Synonyms: malleolus medialis (TA), malleolus tibiae, internal malleolus. Origin of term: Latin *medialis* = of the middle + *malleolus* = little hammer or mallet.

Medial rotation. Movement of ROTATION toward the MEDIAL LINE (CENTRAL AXIS) of the BODY. Synonyms: rotatio interna (TA), endorotatio (TA), rotatio medialis (TA), internal rotation, inward rotation.

Meniscus (meh-NISS-kuss). A crescent-shaped FIBROCARTILAGE pad in the KNEE JOINT, positioned on top of the TIBIA; plural, menisci (meh-NISS-eye *or* meh-NISS-kee). Synonym: meniscus articularis (TA). Origin of term: diminutive of Greek *mene* = moon, crescent.

Mental (MEN-tal). Pertaining to the region of the chin on the front of the face. Synonyms: genial, genian. Origin of term: Latin MENTUM = chin.

Mentalis (men-TAL-iss *or* men-TAY-liss). A V-shaped paired MUSCLE located on the MENTAL region (chin), which protrudes the lower LIP and raises the chin, wrinkling the skin of the chin. Synonyms: musculus mentalis (TA), levator menti, levator labii inferioris. Origin of term: Latin *mentum* = chin.

Mental protuberance. A small, bony bump (PROTUBERANCE) on the front of the lower MANDIBLE that defines the chin region. Synonym: protuberantia mentalis (TA).

Mental tubercles. Two small bumps (TUBERCLES) on either side of the MENTAL area (chin) on the MANDIBLE. Synonym: tuberculum mentale (TA).

Mentolabial sulcus (MEN-toe-LAY-bee-ul SUL-kuss). A small indentation or depression in the skin occurring directly underneath the bottom LIP, above the chin. Synonym: sulcus mentolabialis (TA). Origin of term: Latin *mentum* = chin + *labium* = lip + *sulcus* = furrow, ditch, groove.

Mesomorph (MEZ-oh-morf). One of the three basic body types; characterized by a naturally athletic build, large bones, and well-defined muscular forms. Origin of term: Greek *mesos* = middle + *morphe* = form.

Metacarpal bones (MET-tah-KAR-poll). The five LONG BONES of the HAND, positioned between the CARPAL BONES of the wrist and the PHALANGES of the fingers and THUMB. Synonyms: ossa metacarpi (TA, pl.), ossa metacarpalia I–V (TA), os metacarpale (sing.). Origin of term: Greek *meta* = after + Latin *carpus*, from Greek *karpos* = wrist.

Metacarpo-phalangeal joint, or **MCP joint** (MET-ah KAR-poe-fah-LAN-jee-ul). The JOINT between a METACARPAL BONE and a PHALANX bone in the HAND. Synonyms: articulationes metacarpophalangeae (TA), knuckle of the hand. Origin of term: Greek *meta* = after + Latin *carpus*, from Greek *karpos* = wrist + Greek *phalanx* = line or flank of soldiers.

Metatarsal bones (MET-ah-TAR-sul). The five elongated BONES of the foot, positioned between the TARSAL BONES and phalanges (*see phalanx*). Synonyms: ossa metatarsi (TA, pl.), ossa metatarsalia IV (TA), os metatarsale (sing.). Origin of term: Greek *meta* = after + Late Latin *tarsus* = instep.

Middle finger. The third finger of the HAND. Synonyms: digitus medius (TA), digitus tertius III (TA), third finger, III digit, "bird."

Minor alar cartilage of nose (AY-lar). Three or more small cartilages located near or on each WING OF THE NOSE. Synonyms: cartilagines alares minores (TA), lesser alar cartilage. Origin of term: Latin *ala* = wing + *cartilago* = gristle.

Modiolus (moe-DIE-oh-lus). A small mound at each corner of the mouth where several FACIAL MUSCLES insert (*see* INSERTION). Synonyms: modiolus anguli oris (TA), modiolus labii, nodes, anguli oris, commissural furrow. Origin of term: Latin MODIOLUS = hub of a wheel.

Molar. A tooth with a box-like shape and three to five cusps on the top surface. Adult humans have twelve molars: three at the back of each side of each DENTAL ARCH. Synonym: dens molaris (TA). Origin of term: Latin *mola* = millstone.

Movable joint. *See* FREELY MOVABLE JOINT, SYNOVIAL JOINT

Multiaxial joint. A JOINT that can move in all three ANATOMICAL PLANES. Synonyms: polyaxial joint, triaxial joint.

Multipennate muscle fiber (mull-tee-PEN-ate). Muscle fiber arrangement in which the MUSCLE has multiple TENDON branches with MUSCLE FIBERS attached along both sides of each tendon. The DELTOID muscle has this arrangement. Synonym: musculus multipennatus (TA). Origin of term: Latin *multus* = many + *penna* = feather.

Muscle. A soft tissue form with specialized contractile capabilities. SKELETAL MUSCLES attach to bones or other structures by means of TENDONS. Synonyms: musculus (TA, sing.), musculi (TA, pl.). Origin of term: Latin *musculus* = little mouse.

Muscle fibers. The elongated contractile cells of a MUSCLE.

Muscle group. A set of adjacent muscles that are attached in a similar location and that perform similar functions. *See also* ADDUCTOR GROUP, EXTENSOR GROUP, FLEXOR GROUP, GLUTEAL GROUP, HAMSTRING GROUP, HYPOTHENAR GROUP, QUADRICEPS GROUP, RADIAL GROUP, SCAPULA GROUP, THENAR GROUP, THUMB GROUP

Muscular system. The approximately seven hundred muscles of the adult human body, considered as a whole. Of these, the SKELETAL MUSCLES are of primary interest to artists. Synonym: systema musculare (TA).

Mylohyoid (MY-lo-HI-oyd). A MUSCLE that ATTACHES on the inside surface of the MANDIBLE and inserts into the HYOID BONE of the neck, creating the floor of the mouth and the bottom plane of the jaw. It DEPRESSES (lowers) the jaw in the action of opening the mouth wide. Synonym: musculus mylohyoideus (TA). Origin of term: Greek *myle* = molar tooth + *hyoid* = U-shaped.

Myofibril (MY-oh-FI-bril). One of the elongated, rodlike strands contained within each MUSCLE FIBER. Origin of term: Greek *mys, mylos* = muscle + New Latin *fibrilla*, diminutive of *fibra*, = fiber.

Myofilament (my-o-FILL-ah-ment). A microscopic thread of protein; grouped together in bundles, myofilaments form MYOFIBRILS in SKELETAL MUSCLES. Origin of term: Greek *mys, mylos* = muscle + French *filament*, from Latin *filum* = thread.

Nail fold. The fold of skin overlapping the side and back borders of each nail on the fingers, thumbs, and toes.

Nasal bones. The FACIAL BONES that form the BRIDGE OF THE NOSE. Synonyms: os nasale (TA), nasal eminences, ossea nasalia.

Nasal cavity. An inverted heart-shaped hollow in the front of the SKULL that is positioned behind the CARTILAGE structure of the NOSE. It is partitioned into right and left portions by the NASAL SEPTUM. Synonym: cavum nasi (TA).

Nasalis (nay-ZAL-iss *or* NAY-zah-liss *or* nay-ZAY-liss). A MUSCLE that attaches to the top of the BRIDGE OF THE NOSE. It has two portions: the transverse portion and the alar portion. The transverse portion compresses the NOSTRILS toward the NASAL SEPTUM; the alar portion draws the alar CARTILAGE of the NOSE somewhat downward. Synonyms: musculus nasalis (TA). Origin of term: Latin *nasus* = nose. *See also* MAJOR ALAR CARTILAGE OF THE NOSE, MINOR ALAR CARTILAGE OF THE NOSE

Nasal septum. A partition made of BONE and CARTILAGE that divides the NASAL CAVITY into right and left portions. Synonym: septum nasi (TA).

Nasion. *See* ROOT OF THE NOSE

Nasolabial fold (NAY-zoh-LAY-bee-ul). A skin fold occurring near the WING OF THE NOSE and the corner of the mouth. It appears on the surface form when someone smiles, laughs, or assumes an expression of disgust. Synonyms: sulcus nasolabialis (TA), nasolabial sulcus. Origin of term: Latin *nasus* = nose + *labium* = lip.

Navel. The button-like depression or elevation on the LINEA ALBA, along the center of the abdominal wall. Synonyms: umbilicus, bellybutton.

Navicular bone (nah-VICK-yoo-lar). The intermediate TARSAL BONE of the foot, positioned between the PROXIMAL ROW and the DISTAL ROW OF TARSAL BONES. Synonyms: os naviculare (TA), os naviculare pedis, scaphoid, os navicularis pedis. Origin of term: Latin *navicula* = little ship, boat.

Neck of the femur. A bony strut that projects at an angle from the FEMUR toward the PELVIS. Its bony expansion is the HEAD OF THE FEMUR. Synonym: collum femoris (TA).

Nose. An external structure of the face composed of BONE and CARTILAGE positioned on the NASAL CAVITY of the SKULL. Synonyms: nasus (TA), external nose.

Nostrils. Two small openings on either side of the NASAL CAVITY formed by the CARTILAGE of the NOSE. Synonyms: nares (TA, pl.), naris (TA, sing.), nose holes, nostril holes, anterior nasal apertures.

Nuchal ligament (NEW-kull). A flat, triangular, sail-like LIGAMENT that ATTACHES at the back of the SKULL and along the SPINOUS PROCESSES of the CERVICAL VERTEBRAE of the neck. Synonyms: ligamentum nuchae (TA), posterior cervical ligament. Origin of term: Latin *nucha* = nape of neck.

Oblique. Slanting away diagonally from the SAGITTAL PLANE, CORONAL PLANE, or TRANSVERSE PLANE. Origin of term: Latin *obliquus* = slanting.

Occipital bone (ock-SIP-ih-tal). A CRANIAL BONE located in the lower posterior region of the SKULL. Synonyms: os occipitale (TA), os occipitate. Origin of term: Latin *occiput* = back of head.

Olecranon (oh-LEK-rah-non). The prominent bumplike PROCESS on the ULNA bone; commonly called the elbow. Synonyms: point of elbow, cubitus, tuberositas olecrani, olecranon process. Origin of term: Greek *olene* = elbow + *kranion* = head.

Opponens digiti minimi (oh-POE-nenz DIH-jih-tee MIN-ih-mee *or* oh-POE-nenz DIJ-ih-tic MIN-ih-my). One of the MUSCLES of the HYPOTHENAR GROUP of the HAND. It brings the LITTLE FINGER into OPPOSITION with the THUMB. Synonyms: musculus opponens digiti minimi (TA), opponens digiti quinti, opponens minimi digiti. Origin of term: Latin *opponere* = to oppose + *digitus* = digit (finger) + *minimi* = smallest.

Opponens pollicis (oh-POE-nenz poe-LEE-siss *or* oh-POE-nenz PAWL-lih-kiss). One of the MUSCLE of the THENAR GROUP of the HAND. It brings the THUMB into OPPOSITION with the fingertips of any of the four fingers. Synonyms: musculus opponens pollicis (TA), flexor ossis metacarpi pollicis. Origin of term: Latin *opponere* = to oppose + *pollicis* = of the thumb.

Opposition. A special movement of the THUMB in which the pad of the thumb touches the tip of another finger. Synonym: oppositio (TA). Origin of term: Latin *opponere* = to oppose.

Orbicularis oculi (or-BICK-yoo-LAR-iss OCK-yoo-lie *or* or-BICK-kyoo-LAIR-riss OCK-yoo-lee). A round MUSCLE that completely surrounds the EYE and the borders of the ORBITS (eye sockets). It has two main portions: the orbital portion and the palpebral (eyelid) portion. A third portion, called the lacrimal portion, cannot be seen on the surface form. The orbital portion consists of CIRCULAR MUSCLE FIBERS; when the muscle contracts, it squeezes the eye shut. The palpebral portion gently closes and opens the EYELIDS. Synonyms: musculus orbicularis oculi (TA), orbicularis palpebrarum, orbicular muscle of the eye. Origin of term: Latin *orbiculus* = diminutive of *orbis* = circle, disk + *oculi* = of the eyes. *See also* EYELIDS

Orbicularis oris (or-BICK-yoo-LAR-iss OR-iss *or* or-BICK-kyoo-LAIR-riss OR-iss). The round MUSCLE of the mouth region, including the LIPS. It has CIRCULAR MUSCLE FIBERS. When the orbicularis oris contracts slightly, the lip portion closes the lips gently. In a more forceful contraction, it compresses the lips tightly together. Synonyms: musculus orbicularis oris (TA), whistling muscle, kissing muscle, orbicular muscle of the mouth. Origin of term: Latin *orbiculus* = diminutive of *orbis* = circle, disk + *oris* = of the mouth.

Orbit. Either of the bony cavities of the SKULL that contain the eyeballs. Synonyms: orbita (TA), cavitas orbitalis (TA), orbital cavity, eye socket. Origin of term: Latin *orbita* = trace or track, from *orbis* = wheel.

Origin of a muscle. The point of ATTACHMENT of a MUSCLE on a fixed BONE, which does not move when the muscle contracts; opposite of INSERTION, which is the point of attachment to a bone that does move when the muscle contracts. In medical charts and anatomical SKELETONS, origin points are traditionally indicated in red. Synonyms: punctum fixum (TA), tendon of origin, proximal attachment, stationary point of attachment, fixed end, fixed part of skeleton.

Ossification (OS-sih-fih-KAY-shun). The process by which temporary cartilage is converted to bone. Origin of term: Latin *ossificatio* = to make bone, from *os* = bone + *fascere* = to make.

Outer angle of eye. The outside corner of the EYE. Synonyms: angulus oculi lateralis (TA), external canthus, lateral palpebral commissure, lateral angle of eye, commissura lateralis palpebrarum.

Palate (PAL-at). The bony and muscular roof of the interior of the mouth between the oral cavity and NASAL CAVITIES. Synonym: palatum (TA). Origin of term: Latin *palatum* = palate.

Palatine bones (PAL-uh-tin *or* PAL-uh-teen). A pair of IRREGULAR BONES of the CRANIUM that form part of the bony roof of the mouth (PALATE). Synonyms: os palatinum (TA), palate bones, palatal bones. Origin of term: Latin *palatum* = palate.

Palm. The ANTERIOR surface of the HAND, excluding the fingers and THUMB. It contains distinctive skin folds, including the DISTAL PALMAR CREASE, PROXIMAL PALMAR CREASE, and THENAR CREASE. Synonyms: palma (TA), regio palmaris (TA), palmaris (TA), vola (TA), volaris (TA), palmar, palmar region, volar. Origin of term: Latin *palma* = the palm.

Palmar aponeurosis (PAHL-mar AP-oh-new-ROH-siss *or* PAWL-mer AP-oh-new-ROH-siss). A triangular fibrous tissue attached underneath the skin of the PALMAR SIDE OF THE HAND. Synonyms: aponeurosis palmaris (TA), palmar fascia. Origin of term: Latin *palma* = the palm + Greek *apo* = from + *neuron* = sinew.

Palmar interosseous muscles (PAHL-mar in-tur-OSS-see-us *or* PAWL-mer in-tur-ROSS-ee-us). Four MUSCLES that attach on the first, second, fourth, and fifth METACARPAL BONES. They ADDUCT the fingers, bringing the INDEX FINGER, RING FINGER, and LITTLE FINGER back from a spread-out position. The first palmar interosseous muscle assists in the flexion of the THUMB. Synonyms: musculi interossei palmares (TA, pl.), interossei volares (pl.), volar interosseous (sing.), interosseous volaris (sing.). Origin of term: Latin *palma* = the palm + *interosseous* = between the bones.

Palmaris longus (pahl-MAR-iss LON-gus *or* pahl-MAH-riss LON-gus). A thin muscle on the ANTERIOR side of the FOREARM that begins on the medial EPICONDYLE OF THE HUMERUS and travels downward to insert into the FASCIA of the palm. Synonyms: musculus palmaris longus (TA), long palmar muscle. Latin *palma* = the palm + *longus* long.

Palmar side of the hand (PAHL-mar *or* PAWL-mer). The ANTERIOR surface of the HAND, including the PALM, fingers, and THUMB. Synonyms: regio manus (TA), regio palmaris (TA), hand region, palmar region. Origin of term: Latin *palma* = the palm.

Parallel muscle fibers. Muscle fiber arrangement in which the MUSCLE FIBERS run parallel to the long AXIS of the MUSCLE. There are two types of parallel muscles: FUSIFORM MUSCLE FIBERS and straight muscle fibers, which are straplike. Synonyms: straight muscle, rectus muscle.

Parietal bones (pah-RYE-eh-tul). A pair of thin, curving BONES forming the outer wall of the CRANIUM. Synonyms: os parietale (TA, sing.), ossa parientalia (pl.). Origin of term: Middle Latin *parietalis* = of a wall.

Parotid gland (pah-ROT-id). A large salivary gland located in front of the ear and partially over the MASSETER muscle of the MANDIBLE. Synonyms: glandula parotidea (TA), parotid salivary gland. Origin of term: Greek *parotis* = situated near the ear.

Patella (pah-TELL-ah). The kneecap. The patella is a large SESAMOID BONE within the QUADRICEPS TENDON. Synonyms: bone of knee, knee pan, knee. Origin of term: Latin *patella* = a small plate.

Patellar ligament (pah-TELL-ar). A flat fibrous band (LIGAMENT) that connects from the PATELLA to the TIBIAL TUBEROSITY of the TIBIA. Synonyms: ligamentum patellae (TA), patellar tendon, ligament of patella. Origin of term: Latin *patella* = a small plate.

Pectineus (peck-TIH-nee-us *or* peck-TIN-ee-us). The shortest MUSCLE of the ADDUCTOR GROUP of the inner THIGH. It helps ADDUCT the thigh at the HIP JOINT and participates in the FLEXION of the thigh at the hip joint. Synonym: musculus pectineus (TA). Origin of term: Latin *pecten* = a comb.

Pectoral girdle. *See* SHOULDER GIRDLE

Pectoralis major (PECK-tor-AL-liss MAY-jur). The large muscle of the CHEST. It has three portions: the clavicular portion, the sternal portion, and the abdominal portion. Its main function is to move the upper ARM in the actions of ADDUCTION, FLEXION, and MEDIAL ROTATION. Synonyms: musculus pectoralis major (TA), greater pectoral muscle, pectorals, chest muscle, "pecs." Origin of term: Latin *pectus* = chest + *major* = greater.

Pelvic brim. The large circular opening in the PELVIS. In females it is usually oval in shape; in males, heart shaped. Synonyms: apertura pelvis superior (TA), pelvic inlet.

Pelvic girdle. The semi-bony ring of the lower TORSO constructed by the HIP BONES of the PELVIS. The lower limbs attach to this girdle. Some experts include the SACRUM in the pelvic girdle; others do not. Synonyms: cingulum pelvicum (TA), cingulum membri inferioris (TA), hip girdle.

Pelvis (PEL-viss). The bowl-shaped bony structure at the lower part of the TORSO, comprising the two HIP BONES and the SACRUM. Synonyms: cingulum pelvicum (TA), cingulum membri inferioris (TA), hip, pelvic girdle. Origin of term: Latin *pelvis* = basin.

Pennate muscle fibers (PEN-ate). Muscle fiber arrangement in which short MUSCLE FIBERS are connected at an OBLIQUE angle to a TENDON. There are three types: BIPENNATE MUSCLE FIBERS, MULTIPENNATE MUSCLE FIBERS, and UNIPENNATE MUSCLE FIBERS. Synonyms: musculus pennatus (TA), penniform muscle. Origin of term: Latin PENNA = feather.

Peroneus brevis (pair-oh-NEE-us BREV-iss *or* pair-ROWN-ee-us BREH-viss). The short MUSCLE on the LATERAL side of the FIBULA. Together with the PERONEUS LONGUS, it helps in the movements of PLANTAR FLEXION and EVERSION of the foot, stabilizes the outer ankle, and assists in supporting the arches of the foot. Synonyms: musculus peroneus brevis (TA), muscular fibularis brevis (TA), fibularis brevis, short peroneal muscle. Greek *perone* = the fibula (brooch or buckle) + Latin *brevis* = short.

Peroneus longus (pair-oh-NEE-us LON-gus *or* pair-ROWN-ee-us LON-gus). The long MUSCLE on the LATERAL side of the FIBULA. Together with the PERONEUS BREVIS, it helps in the movements of PLANTAR FLEXION and EVERSION of the foot, stabilizes the outer ankle, and assists in supporting the arches of the foot. Synonyms: musculus peroneus longus (TA), muscular fibularis longus (TA), long fibular muscle, fibularis longus, long peroneal muscle. Origin of term: Greek *perone* = the fibula (brooch or buckle) + Latin *longus* = long.

Pes anserinus (pess an-sir-EYE-nuss *or* pez an-sir-EYE-nuss). The goosefoot-shaped form created by three TENDONS of the HAMSTRING GROUP (GRACILIS, SARTORIUS, SEMITENDINOSUS) of the THIGH where they ATTACH into the MEDIAL surface of the TIBIA. Synonym: goosefoot. Origin of term: Latin *pes* = foot + *anserinus* = of a goose.

Phalanx (FAY-links *or* FAY-lanks)/**phalanges** (fah-LAN-jeez). Singular and plural forms, respectively, for the BONES of the fingers, toes, and THUMB. With the exception of the thumb and the great toe (HALLUX), each finger or toe has three phalanges; the thumb and great toe each have two phalanges. The phalanx closest to a digit's attachment on the HAND or foot is known as the PROXIMAL phalanx; that farthest away is called DISTAL phalanx. The intermediate phalanges of the four fingers and four lesser toes are known as the middle phalanges. Synonym: ossa digitorum (TA, pl.). Origin of term: Greek *phalanx* = line or flank of soldiers.

Philtrum (FILL-trum). A vertical depression in the skin between the bottom of the NOSE and the upper LIP. Synonym: infranasal depression. Origin of term: Greek *philtron* = love charm.

Pisaform bone (PIZ-ih-form). A pea-shaped CARPAL BONE located in the PROXIMAL ROW OF CARPAL BONES of the wrist region. Synonym: os pisaforme (TA). Origin of term: Latin *pisum* = pea.

Pit of the neck. The notch-like space, or depression, on the skin above the STERNUM and between the inner ends of the collar bones (CLAVICLES). Synonyms: incisura jugularis (TA), suprasternal notch, jugular notch.

Pivot joint. A FREELY MOVABLE JOINT in which the rounded end of one BONE rotates within a ringlike structure formed by another bone or a LIGAMENT. Synonyms: articulatio trochoidea (TA), rotary joint, rotatory joint, trochoid joint, swivel joint.

Plane joint. A JOINT in which two BONES with flattened or slightly curved surfaces glide across each other. Synonyms: articulatio plana (TA), arthrodia, arthrordial joint, gliding joint.

Plantar aponeurosis (PLAN-tar AP-uh-new-ROH-siss). A FASCIA positioned underneath the skin of the sole of the foot (PLANTAR SIDE OF THE FOOT). Synonyms: aponeurosis plantaris (TA), plantar fascia. Origin of term: Latin *planta* = sole of foot + Greek *apo* = from + *neuron* = sinew.

Plantar flexion (PLAN-tar). A movement of the foot at the ANKLE JOINT in which the toes and foot point downward. Origin of term: Latin *planta* = sole of foot + *flectere* = to bend.

Plantar side of the foot (PLAN-tar). The bottom side of the foot, including the sole and the bottoms of the toes. Synonyms: planta (TA), plantaris (TA), regio plantaris (TA), plantar region, sole of foot, bottom of foot. Origin of term: Latin *planta* = sole of foot.

Plastination (plas-tih-NAY-shun). An anatomical preservation technique developed in the late twentieth century by German physician Gunther von Hugens in which the cells of human or animal tissue are infused and hardened with reactive polymers. Plastinated specimens of dissected cadavers and body parts have been exhibited worldwide.

Popliteal fossa (pop-LIT-ee-al FOSS-ah *or* pa-pal-TEE-al FOSS-ah). A diamond-shaped space at the back of the KNEE JOINT positioned above the HEADS of the GASTROCNEMIUS muscle and flanked by the TENDONS of the HAMSTRING GROUP of MUSCLES. Synonyms: fossa poplitea (TA), popliteal space, ham, hollow behind the knee, poplitaeus. Origin of term: Latin *poples* = ham.

Posterior (poss-TEER-ee-or). A direction/location term referring to the back surface of the body or a body part. Origin of term: Latin *posterus* = coming after.

Posterior border of the ulna. A crestlike edge along the back portion of the ULNA bone of the FOREARM. The ULNA FURROW usually occurs along this border. Synonyms: margo posterior (TA), ulnar crest, crest of ulna, margo dorsalis.

Posterior superior iliac spine, or **PSIS.** Either of the POSTERIOR ends of the ILIAC CRESTS on the PELVIS, which create dimples on the skin on both sides of the top border of the SACRUM bone. Synonyms: spina iliac posterior superior (TA), inferior lateral lumbar fossa. Origin of term: Latin *posterus* = coming after + *superioris* = higher + *ilium* = groin, flank + *spina* = spine, thorn. *Compare* ANTERIOR SUPERIOR ILIAC SPINE

Posterior triangle. A triangular depression in the skin between the TRAPEZIUS muscles, the outer edge of the STERNOCLEIDOMASTOID muscle, and the CLAVICLE bones. The upper portion of the posterior triangle is called the occipital region; the lower portion is referred to as the SUPRACLAVICULAR FOSSA. Synonyms: regio cervicalis lateralis (TA), trigonum cervicale posterius (TA), trigonum colli laterale (TA), lateral cervical region, posterior cervical triangle.

Power grip. A handgrip mainly implemented by the EXTRINSIC MUSCLES OF THE HAND. This grip is used when strength is needed to grasp objects.

Precision grip. A handgrip mainly implemented by the INTRINSIC MUSCLES OF THE HAND. This grip allows for delicate control of the THUMB and fingers when grasping small objects or performing actions requiring great technical skill, as when playing a musical instrument.

Premolar (pree-MO-lar). A tooth with two tubercles, or cusps, on the upper portion. There are two premolars, located between the CANINE and the MOLARS, on each side of each DENTAL ARCH. Synonyms: dens premolaris (TA), bicuspid. Origin of term: Latin *prae* = before + *mola* = millstone.

Procerus (pro-SAIR-us *or* pro-SEE-rus *or* pro-SIR-us). A small fan-shaped MUSCLE located between the FRONTALIS and the ORBICULARIS OCULI muscles on the forehead. It DEPRESSES (lowers) the inner ends of the eyebrows. on the forehead. Synonyms: musculus procerus (TA), pyramidalis nasi, depressor glabellae. Origin of term: Latin *procerus* = long, tall.

Process. A general term for any bony PROMINENCE or projection occurring on a BONE. Synonym: processus (TA).

Prominence. A prominent projection on the surface of a BONE. Synonym: prominentia (TA).

Pronate (PRO-nate). To turn the FOREARM and HAND in a PALM-down position or, in the ANATOMICAL POSITION, to turn the hand backward. Origin of term: Latin *pronare* = to bend forward.

Pronation (pro-NAY-shun). The MEDIAL ROTATION of the FOREARM (RADIUS and ULNA bones), which moves the hand to a palm-down position or that, in the ANATOMICAL POSITION, moves the palm to face backward. Synonym: pronatio (TA). Origin of term: Latin *pronare* = to bend forward.

Pronator (pro-NAY-tor). A MUSCLE that assists in turning the PALM of the HAND downward if the ELBOW of the lower arm is flexed (bent) or that, in the ANATOMICAL POSITION, moves the palm to face backward. Origin of term: Latin *pronare* = to bend forward.

Pronator teres (pro-NAY-tor TEH-reez *or* pro-NAY-tor TEH-reez). An OBLIQUE muscle of the ANTERIOR side of the FOREARM that begins on the medial EPICONDYLE OF THE HUMERUS and inserts into the RADIUS. It plays the major role in turning the palm of the HAND backward (if the upper arm and lower arm are in the ANATOMICAL POSITION) or downward (if the elbow of the lower arm is flexed). It also assists in the FLEXION of the ELBOW JOINT. Synonyms: musculus pronator teres (TA), pronator radii teres, round rotator muscle. Origin of term: Latin *pronare* = to bend forward + *teres* = rounded.

Protraction (pro-TRACK-shun). A movement in which the lower jaw (MANDIBLE) or SCAPULA bones are moved forward. Synonym: protrusion. Origin of term: Latin *pro* = forward + *trachere* = to draw.

Protuberance (pro-TOO-burr-ents). A protruding projection or knoblike outgrowth on a BONE. Synonym: protuberantia (TA). Origin of term: Latin *protuberare* = to swell.

Proximal (PROCK-sih-mal). A location term referring to the part of an ARM, LEG, HAND, foot, finger, or toe that is closest to that body part's point of attachment. Synonym: proximalis (TA). Origin of term: Latin *proximus* = nearest, next. *Compare* DISTAL

Proximal inter-phalangeal joint, or **PIP joint.** The INTER-PHALANGEAL JOINT that is closest to a finger or thumb's attachment on the HAND or a toe's attachment on the foot. *Compare* DISTAL INTER-PHALANGEAL JOINT

Proximal palmar crease. A crease on the palm of the HAND that begins near the THENAR CREASE and travels across the palm slightly diagonally. Synonyms: transverse proximal crease, head line, oblique fold of the palm, oblique furrow, oblique line.

Proximal row of carpal bones. The row of CARPAL BONES positioned closer to the ULNA and RADIUS bones of the FOREARM and containing the SCAPHOID, LUNATE, TRIQUETRAL, and PISAFORM bones. *Compare* DISTAL ROW OF CARPAL BONES

Proximal row of tarsal bones. The row of TARSAL BONES closer to the ankle and containing the CALCANEUS (heel bone) and TALUS bone. *Compare* DISTAL ROW OF TARSAL BONES, NAVICULAR

PSIS. *See* POSTERIOR SUPERIOR ILIAC SPINE

Pterygo-mandibular raphe (TER-ih-go-man-DIB-yoo-lar RAH-fee *or* TER-ih-go-man-DIB-yoo-lar RAY-fee). A tendinous band between the MANDIBLE and a hook-like projection (pterygoid hamulus) on the SPHENOID bone of the SKULL. The raphe is a point of ATTACHMENT for the BUCCINATOR muscle. Synonym: raphe pterygomandibularis (TA). Origin of term: Greek *pteryx, pterygos* = wing + Latin *mandibula* = lower jawbone + Greek *rhaphe* = suture, seam.

Pubic angle (PYOO-bick). An angle formed by the bony arch (arcus pubicus [TA], pubic arch) of the lower part of the PUBIC BONE and part of the ISCHIUM. The angle creates a triangular space between the pair of bones and is generally wider in the female PELVIS than in the male pelvis. Synonyms: angulus subpubicus (TA), subpubic angle, angulus pubis.

Pubic bone (PYOO-bick). Either of the pair of BONES that together create a bridge of bone in the lower front region of the PELVIS. Synonyms: os pubis (TA), pubis, bone of the groin. Origin of term: Latin *pubes* = adult.

Pubic symphysis (PYOO-bick SIM-fih-siss). The joint between the two PUBIC BONES, which contains a connective pad of FIBROCARTILAGE. Synonyms: symphysis pubica (TA), symphysis ossium pubis. Origin of term: Greek *symphysis* = a growing together + Latin *pubes* = adult.

Pubis (PYOO-bis). The pair of PUBIC BONES, which together create a bridge of BONE in the lower front region of the PELVIS. Synonyms: os pubis (TA), pubic bone(s), bone of the groin. Origin of term: Latin *pubes* = adult.

Pull of action. The direction of the action produced by a contracting muscle. Synonym: line of action.

Pupil. A small dark orifice in the center of the IRIS of the EYE that dilates (grows larger) or constricts (grow smaller) according to the amount of light entering it. Synonym: pupilla (TA). Origin of term: Latin *pupilla* = pupil of the eye.

Pyramidalis (PIR-ah-mih-DAY-lis *or* PEER-ah-mid-AL-iss). A small triangular MUSCLE at the base of the RECTUS ABDOMINIS muscle. It ATTACHES on the PUBIC BONE and inserts into the lower portion of the LINEA ALBA. Its function is to help make the linea alba tense. Synonyms: musculus pyramidalis (TA), pyramidal muscle. Origin of term: Greek *pyramidos* = pyramid.

Quadratus labii superioris group (kwahd-RAH-tus LAY-bee-eye soo-PEER-ee-OR-iss). The HEADS of the LEVATOR LABII SUPERIORIS ALAEQUE NASI, LEVATOR LABII SUPERIORIS, and ZYGOMATICUS MINOR muscles, considered as a MUSCLE GROUP. Synonym: musculus quadratus labii superioris. Origin of term: Latin *quadratus* = square + *labium* = lip + *superioris* = higher.

Quadriceps group (KWAHD-rih-seps). The four-headed MUSCLE GROUP on the ANTERIOR side of the THIGH, including the RECTUS FEMORIS, VASTUS INTERMEDIUS, VASTUS LATERALIS, and VASTUS MEDIALIS muscles. The quadriceps mainly functions to EXTEND the lower LEG at the KNEE JOINT. Synonyms: musculus quadriceps femoris (TA), compartimentum femoris anterius (TA), compartimentum femoris extensorum (TA), quadriceps extensor femoris, anterior compartment of thigh, extensor compartment of thigh, quadriceps, quadriceps femoris, triceps femoralis, quadriceps extensor cruris, upper thigh muscles, four-headed muscle of femur (thigh), "quads." Origin of term: Latin *quad* = four + *ceps* = head.

Quadriceps tendon. The common TENDON of the four MUSCLES of the QUADRICEPS GROUP. It ATTACHES into the PATELLA and continues into the TIBIAL TUBEROSITY of the TIBIA. Synonym: tendon of quadriceps.

Radial (RAY-dee-ul). Relating to the RADIUS bone of the FOREARM. Origin of term: Latin *radialis* = pertaining to the radius bone.

Radial abduction (RAY-dee-ul ab-DUCK-shun). A movement of the HAND in which it leans sideways from the wrist on the RADIAL side of the FOREARM. Synonym: radial deviation. Origin of term: Latin *radialis* = pertaining to the radius bone + *abducere* = to lead or take away.

Radial group. The BRACHIORADIALIS and EXTENSOR CARPI RADIALIS LONGUS considered as a separate MUSCLE GROUP because together they create a rich spiraling form on the lower arm. This form starts on the outside of the HUMERUS, near the ELBOW JOINT, and descends along the RADIUS bone (hence the name), toward the THUMB.

Radius bone (RAY-dee-us *or* ray-DEE-us). One of the two BONES of the FOREARM. (The other is the ULNA.) The radius is positioned on the THUMB side of the HAND when the arm is in the ANATOMICAL POSITION. Synonym: lower arm (along with the ulna). Origin of term: Latin *radialis*, from *radius* = ray, rod, or spoke of a wheel.

Ramus (RAY-muss). A bone feature (e.g., the ramus of the MANDIBLE, the ramus of the ISCHIUM) that projects at an angle from the main BODY of a BONE. Synonym: branch. Origin of term: Latin *ramus* = branch.

Range of motion, or ROM. A measurement of the normal range of movement between the flexed position (*see* FLEXION) and the extended position (*see* EXTENSION) of a particular JOINT or MUSCLE GROUP.

Raphe (RAH-fee *or* RAY-fee). A tendinous band (*see* TENDON) located between MUSCLES or within the muscle structure. Origin of term: Greek *rhaphe* = suture, seam.

Rectus abdominis (RECK-tuss ab-DOM-ih-niss). The large MUSCLE of the ABDOMEN region. Its main action is to bend the TORSO forward at the waist in the FLEXION of the VERTEBRAL COLUMN. It also helps raise the BODY from a supine position to a sitting-upright position. Synonyms: musculus rectus abdominis (TA), rectus muscle of abdomen, belly, "abs," "six-pack," "washboard," straight muscle of the abdomen. Origin of term: Latin *rectus* = straight + *abdomen* = belly.

Rectus femoris (RECK-tus FEM-o-riss *or* RECK-tus FEM-mor-iss *or* RECK-tus fem-MORE-iss). One of the four MUSCLES of the QUADRICEPS GROUP of the THIGH. Positioned in the middle of the group, it flexes the thigh from the HIP JOINT. Synonyms: musculus rectus femoris (TA), kicking muscle, straight muscle of the femur. Origin of term: Latin *rectus* = straight + *femoris* = of the femur (or thigh).

Reposition. The movement of return to the ANATOMICAL POSITION of the THUMB from its placement in OPPOSITION. Synonyms: repostio (TA), neutral position, original position. Latin *re* = back + *ponere* = to place.

Retinaculum (ret-ih-NAK-yoo-lum). Any of the retaining bands (pl. retinacula) of FASCIA that wrap like bracelets around the ANKLE JOINT or WRIST JOINT and that help hold the many tendons that run beneath the band in place. Origin of term: Latin RETINACULUM = a band or halter. *See also* EXTENSOR RETINACULUM OF HAND, FLEXOR RETINACULUM OF HAND, INFERIOR EXTENSOR RETINACULUM OF FOOT, SUPERIOR EXTENSOR RETINACULUM OF LOWER LEG

Retraction. A movement in which the MANDIBLE or SCAPULA bones are drawn back. Synonym: retrusion. Origin of term: Latin *re* = back + *trachere* = to draw.

Rhomboid major (ROM-boyd MAY-jur). The larger of the two rhomboid MUSCLES of the back, which ATTACHES from the VERTEBRAL COLUMN into the VERTEBRAL BORDER OF THE SCAPULA. It and the RHOMBOID MINOR work together to move the SCAPULA bones to different positions in the actions of ADDUCTION, downward ROTATION, and ELEVATION. Synonyms: musculus rhomboideus major (TA), greater rhomboid. Origin of term: Greek *rhombus* = diamond shaped + Latin *major* = greater.

Rhomboid minor (ROM-boyd MY-nur). The smaller of the two rhomboid MUSCLES of the back, which ATTACHES from the VERTEBRAL COLUMN into the VERTEBRAL BORDER OF THE SCAPULA. It and the RHOMBOID MAJOR work together to move the SCAPULA bones to different positions in the actions of ADDUCTION, downward ROTATION, and ELEVATION. Synonyms: musculus rhomboideus minor (TA), lesser rhomboid. Greek *rhombus* = diamond shaped + Latin *minor* = lesser.

Ribcage. The BONES and CARTILAGE (including the RIBS, STERNUM, THORACIC VERTEBRAE, and COSTAL CARTILAGES) that together create a birdcage structure that protects the heart and lungs. Synonyms: cavea thoracis (TA), thoracic cage, thorax, thoracic basket.

Ribcage arch. *See* THORACIC ARCH

Ribs. The elongated, curved FLAT BONES that attach in pairs on either side of the VERTEBRAL COLUMN, curving around toward the front of the body and forming the overall structure of the RIBCAGE. The TRUE RIBS attach directly into the STERNUM with their own individual COSTAL CARTILAGES; the FALSE RIBS (ribs 8, 9, 10) share a branch of costal cartilage that inserts into the sternum; and the FLOATING RIBS) (ribs 11, 12) do not connect into the sternum at all. Synonym: costae (TA).

Ring finger. The fourth DIGIT of the HAND. Synonyms: digitus anularis (TA), digitus quartus (TA), IV digit.

Root of the nose. The place on the face, approximately between the eyes, where the nose emerges from the facial plane. Synonyms: radix nasi (TA), radii nasii (TA), nasion, nasal point.

Rotation. A movement in which a body part or BONE turns on its own AXIS. Synonyms: rotatio (TA). Origin of term: Latin *rotare* = to turn. *See also* CIRCUMDUCTION, LATERAL ROTATION, MEDIAL ROTATION

Rhythmic movement of the forms. When depicting a figure, the stressing or slight exaggeration of certain obvious contours or muscle shapes to emphasize their interconnection and visually rhythmic pattern. This technique produces a cohesive flow of movement throughout the figure; it can be in stationary as well as animated depictions of the figure. Synonym: rhythm of the forms.

Sacral triangle (SAY-kral). The soft triangular shape seen on the surface form of the pelvic region of the POSTERIOR lower TORSO. The top border of the triangle runs between the two dimples created by the POSTERIOR SUPERIOR ILIAC SPINES; the downward-pointing apex is just above the GLUTEAL CLEFT. Synonyms: regio sacralis (TA), triangle bone of the pelvis, sacral region. Origin of term: Latin *sacrum* = sacred.

Sacrospinalis (SAY-kro-spih-NAL-iss *or* SAY-kro-spy-NAY-liss). The elongated MUSCLE that ATTACHES along the VERTEBRAL COLUMN from the SACRUM bone of the PELVIS. It has three portions: the iliocostalis (lateral) portion, the longissimus (intermediate) portion, and the spinalis (medial) portion. The main function of this complex muscle is to maintain the vertebral column in an erect position. When the muscle on both sides of the spine contracts, it bends the vertebral column backward in the movement known as either EXTENSION or HYPEREXTENSION. It also assists in the LATERAL FLEXION, or side bending, of the torso. Synonyms: musculus erector spinae (TA), erector spinae. Origin of term: Latin *sacro* = sacral + *spina* = thorn, spine.

Sacrum (SAY-krum). The triangular bone of fused VERTEBRAE at the base of the VERTEBRAL COLUMN. It is the central structure of the PELVIS. Synonyms: os sacrum (TA), vertebrae sacrales (TA), sacral triangle, triangle bone of the pelvis, sacral vertebrae. Origin of term: Latin *sacrum* = sacred.

Saddle joint. A SYNOVIAL JOINT in which the two articulating ends of the bones, shaped somewhat like saddles with convex and concave surfaces, are positioned perpendicularly, one overtop the other. Synonyms: articulatio sellaris (TA), sellar joint, reciprocal reception.

Sagittal plane (SAAJ-ih-tul). The ANATOMICAL PLANE that vertically divides the BODY into equal right and left halves. Vertical divisions that run parallel to the sagittal plane, dividing the body into unequal right and left portions, are called parasagittal or paramedian planes. Synonyms: plana sagittalia (TA), plana medianum (TA), median plane, midsagittal plane, median-sagittal plane. Origin of term: Latin *sagitta* = resembling an arrow.

Sartorius (sar-TOR-ee-us). A long, straplike MUSCLE of the upper leg that begins on the PELVIS and inserts on the TIBIA of the lower LEG. It is positioned between the muscles of the ADDUCTOR GROUP and the QUADRICEPS GROUP. It helps other muscles to bring the lower leg into a cross-legged position. Synonyms: musculus sartorius (TA), tailor's muscle. Origin of term: Greek *sartor* = tailor.

Scaphoid bone (SKAFF-oyd). One of the CARPAL BONES of the PROXIMAL ROW OF CARPAL BONES in the wrist region. Synonyms: os scaphoideum (TA), carpal navicular, navicular of wrist. Origin of term: Greek *skaphe* = skiff, boat.

Scapula (SKAP-yoo-lah). Either of two flat, slightly elongated, triangular BONES attached to the POSTERIOR side of the RIBCAGE, on either side of the VERTEBRAL COLUMN; more commonly known as the shoulder blades. Synonyms: blade bone, omoplate. Origin of term: Latin *scapula* = shoulder blade.

Scapula group (SKAP-yoo-lah). The MUSCLE GROUP that attaches on the SCAPULA bone and inserts into the HUMERUS. The INFRASPINATUS, SUPRASPINATUS, TERES MAJOR and TERES MINOR muscles belong to this group.

Sclera (SKLER-ah *or* SKLEH-rah). The layer of dense, opaque, fibrous tissue that creates the "white of the eye." Synonyms: sclerotica, sclerotic. Origin of term: Latin *sclera*, from Greek *skleros* = hard.

Semilunar line (sem-ee-LOO-nar). A furrow between the outer edge of the RECTUS ABDOMINIS and EXTERNAL OBLIQUE muscles of the ABDOMEN region. Synonyms: linea semilunaris (TA), Spigelius line. Origin of term: Latin *semi* = half + *luna* = moon.

Semimembranosus (SEM-ee-mem-brah-NO-suss *or* seh-MY-mem-bran-OH-suss). A MUSCLE of the HAMSTRING GROUP that is medially positioned on the back of the THIGH, underneath the SEMITENDINOSUS muscle. With the other hamstring muscles, it EXTENDS the THIGH at the HIP JOINT and FLEXES the lower LEG at the KNEE JOINT. With the semitendinosus, it produces the MEDIAL ROTATION of the TIBIA (when the knee is flexed). Synonym: musculus semimembranosus (TA). Origin of term: Latin *semi* = half + *membrana* = thin skin, membrane, parchment.

Semitendinosus (SEM-ee-TEN-dih-NO-suss *or* seh-MY-ten-din-OH-suss). A MUSCLE of the HAMSTRING GROUP that is positioned over the SEMIMEMBRANOSUS on the MEDIAL side of the POSTERIOR portion of the THIGH. With the other hamstring muscles, it EXTENDS the THIGH at the HIP JOINT and FLEXES the lower LEG at the KNEE JOINT. With the semimembranosus, it produces the MEDIAL ROTATION of the TIBIA (when the knee is flexed). Synonym: musculus semitendinosus (TA). Origin of term: Latin *semi* = half + *tendo* = to stretch or extend (pertaining to tendons or sinews).

Septal cartilage of the nose (SEP-tul). A single cartilage in the midline of the NOSE that forms the ANTERIOR part of the NASAL SEPTUM. Synonyms: cartilagio septi nasi (TA), septal nasal cartilage. Origin of term: Latin *septum* = partition.

Septum (SEP-tum). A wall of connective tissue that divides a cavity or large area of soft tissue into two sections (pl., septa). Origin of term: Latin *septum* = partition.

Serratus anterior (sir-AA-tuss an-TEER-ee-or *or* sir-RAT-tuss an-TEER-ee-or *or* sir-RAH-tuss an-TEER-ee-or *or* sir-RAY-tuss an-TEER-ee-or *or* SIR-ah-tus an-TEER-ee-or). A fan-shaped MUSCLE consisting of eight or nine fleshy DIGITATIONS that begin from the outer surfaces of the upper eight or nine RIBS on the side of the THORAX. The muscle ATTACHES into the undersurface of the SCAPULA. Its main function is to retract (ABDUCT) and rotate the scapula. Synonyms: musculus serratus anterior (TA), serratus magnus, "boxer's muscle." Origin of term: Latin *serra* = a saw, saw-toothed or serrated edge + *anterior* = in front of.

Sesamoid bone (SESS-a-moyd). An individual BONE embedded within a TENDON near a JOINT. Synonym: ossa sesamoidea (TA). Origin of term: Greek *sesamoeides* = like a sesame seed.

Seventh cervical vertebra. The most prominent of the CERVICAL VERTEBRAE of the neck, forming a small bump at the base of the neck in back and side views. Synonyms: vertebra prominens (TA), prominent vertebrae of the neck, CVII.

Shaft of the femur. The elongated portion of the FEMUR, between the HEAD OF THE FEMUR and the CONDYLES OF THE FEMUR. Synonyms: corpus femoris (TA), body of femur.

Shaft of the humerus. The elongated portion of the HUMERUS, between the HEAD OF THE HUMERUS and the EPICONDYLES OF THE HUMERUS. Synonyms: corpus humeri (TA), body of humerus.

Short bones. A category of BONES that are about equal in length and width. The CARPAL BONES of the HAND and the TARSAL BONES of the foot include a number of short bones. Synonym: os breve (sing., TA).

Shoulder girdle. The semi-bony ring of the shoulder area formed by the CLAVICLES, the SCAPULA bones, and the MANUBRIUM of the STERNUM. The UPPER LIMBS attach to this girdle. Synonyms: cingulum pectorale (TA), cingulum membri superioris (TA), pectoral girdle, girdle of upper extremity.

Shoulder joint. The BALL-AND-SOCKET JOINT of the shoulder, consisting of the HEAD OF THE HUMERUS and the GLENOID FOSSA of the SCAPULA. Synonyms: articulatio humeri (TA), articulatio glenohumeralis (TA), humeral joint, glenohumeral joint.

Skeletal muscle. MUSCLES composed of bundles of MUSCLE FIBERS that ATTACH to the BONES of the SKELETON by TENDONS. Because they influence the shape of the surface form, skeletal muscles are the muscles of most interest to artists. Synonyms: voluntary muscle, striated muscle.

Skeleton. The bony framework or inner scaffolding of the BODY. Synonyms: systema skeletale (TA), skeletal system, internal scaffolding, architecture of the body, bones of the body.

Skull. The entire skeletal structure of the head, including the CRANIAL BONES and the FACIAL BONES. *See also* CRANIUM

Slightly movable joint. A JOINT that has a limited capacity for movement. Slightly movable joints include the intervertebral joints of the VERTEBRAL COLUMN. Synonym: amphiarthrosis (TA).

Sling of the digastric. A fibrous loop that helps ATTACH the TENDON of the DIGASTRIC muscle of the MANDIBLE to the HYOID BONE of the neck. Synonyms: aponeurosis sling, supra-hyoid aponeurosis.

Soleus (SO-lee-us *or* SOL-ee-us). The MUSCLE positioned underneath the GASTROCNEMIUS (calf muscle) on the POSTERIOR side of the lower LEG. With the gastrocnemius, it produces the PLANTAR FLEXION of the foot and helps raise the heel from the ground in the action of standing on tiptoe. Synonym: musculus soleus (TA). Origin of term: Latin *solea* = a flat fish (the sole) or a leather sole strapped on the foot (a sandal).

Special anatomical movements. *See* DEPRESSION, DORSIFLEXION, ELEVATION, EVERSION, INVERSION, OPPOSITION, PLANTAR FLEXION, PROTRACTION, REPOSITION, RETRACTION.

Sphenoid bone (SFEE-noyd). An IRREGULAR BONE of the CRANIAL FLOOR. Synonyms: os sphenoidale (TA), sphenoidal bone. Origin of term: Greek *sphenoeides* = resembling a wedge.

Spinal column. *See* VERTEBRAL COLUMN

Spine (of a bone). A sharp, slender, pointed PROCESS on a BONE. Origin of term: Latin SPINA = thorn, spine.

Spine of the scapula. The prominent projecting ridge on the SCAPULA bone. Synonym: spina scapulae (TA).

Spinous process (SPY-nus). The central bony projection protruding from the POSTERIOR side of most VERTEBRAE. Synonyms: processus spinosus (TA), sphenoidal spine, vertebral spine. Latin *spina* = thorn, spine.

Spongy bone. The type of osseous tissue that forms the weblike interior structure of BONES. Synonyms: substantia spongiosa (TA), substantia trabecularis (TA), cancellous bone, trabecular bone.

"Squash and stretch." A term used by some figurative artists, especially animators, to describe the dynamics of muscles changing their shape in movement. It is equivalent, in anatomical terms, to the dynamics of the AGONIST MUSCLES and ANTAGONIST MUSCLES. Synonym: "compress and stretch."

Stabilizer muscle. A MUSCLE that immobilizes one or more bones to prevent undesirable movement while another bone is moving. Synonym: fixator muscle.

Sternal angle. The transitional angle between the MANUBRIUM and the BODY OF THE STERNUM. Synonyms: angulus sterni (TA), Ludwig angle, Louis angle, angulus Ludovici, manubriosternal junction, manubriosternal angle, angle of Louis.

Sternocleidomastoid (STIR-no-KLIE-doe-MASS-toyd). A long straplike MUSCLE on either side of the neck. It has two HEADS—the sternal (medial) head and the clavicular (lateral) head—which begin on the MANUBRIUM of the STERNUM and on the CLAVICLE, respectively, and insert into the MASTOID PROCESS of the SKULL. The muscle helps move the head into different positions, bending it downward (FLEXION), bending it sideways LATERAL FLEXION, and causing it to swivel (ROTATION). Synonyms: musculus sternocleidomastoideus (TA), sternomastoid, SCM. Origin of term: Greek *sternon* = chest + *cleis* = resembling a key + *mastoid* = breastlike.

Sternum (STIR-num). The elongated FLAT BONE at the ANTERIOR center of the RIBCAGE to which the first seven RIBS (the TRUE RIBS) ATTACH via COSTAL CARTILAGE; commonly known as the breastbone. The sternum has three portions: the MANUBRIUM, the BODY OF THE STERNUM, and the XIPHOID PROCESS. Origin of term: Greek *sternon* = chest.

Styloid process of the radius (STY-loyd). A conical projection on the wide lower end of the RADIUS bone. Synonyms: processus styloideus radii (TA), radial styloid process. Origin of term: Greek *stylos* = pillar, post, peg + *eidos* = resemblance.

Styloid process of the ulna (STY-loyd). A small spur-like form that projects downward from the HEAD OF THE ULNA of the FOREARM. Synonyms: processus styloideus ulnae (TA), ulnar styloid process. Origin of term: Greek *stylos* = pillar, post, peg + *eidos* = resemblance.

Subcutaneous fat (SUB-kyoo-TAY-nee-us). A layer of loose connective tissue, containing fat cells, that lies immediately beneath the skin. Synonyms: panniculus adipose (TA), fatty layer, fatty tissue, adipose tissue, subcutaneous layer, subcutaneous tissue. Origin of term: Latin *sub* = below + *cutanea* = the skin.

Sulcus (SUL-kus). A long furrow or slight depression occurring in the skin. Origin of term: Latin *sulcus* = furrow, ditch, groove.

Superciliary arch. *See* BROW RIDGE

Superficial fascia (FASH-ee-ah *or* FAY-shee-ah). Fibroelastic FASCIA underneath the skin that contains SUBCUTANEOUS FAT or fatty tissue. Synonyms: hypodermis (TA), tela-subcutanea (TA), subcutaneous tissue, subcutaneous fascia, fibroelastic tissue, subcutaneous layer, fascia superficialis.

Superficial layer of muscles. MUSCLES that are near the skin and thus have a greater influence on the surface form than those of the DEEP LAYER OF MUSCLES. Synonym: superficialis (TA).

Superior. A direction/location term meaning "situated above" or "directed upward"; opposite of INFERIOR. Origin of term: Latin *superioris* = higher.

Superior extensor retinaculum of lower leg (eks-STEN-sor ret-ih-NAK-yoo-lum). The RETINACULUM, or restraining LIGAMENT band, that holds down the extensor TENDONS of the lower LEG above the ANKLE JOINT. Synonyms: retinaculum musculorum extensorum superius (TA), transverse cural ligament, annular ligament. Origin of term: Latin *superioris* = higher + *extendere* = to stretch out + *retinaculum* = a band or halter.

Superior temporal line. A curved ridge on the upper sides of the CRANIUM where the TEMPORALIS muscle's FASCIA is attached. Synonyms: linea temporalis superioris (TA), temple lines.

Supinate (SOO-pi-nate). To rotate the FOREARM so that the palm of the HAND faces upward or forward (as in the ANATOMICAL POSITION). Origin of term: Latin *supinus* = lying on the back.

Supination (SOO-pih-NAY-shun). A LATERAL ROTATION of the FOREARM (RADIUS and ULNA bones), in which the palm of the HAND faces upward or forward (as in the ANATOMICAL POSITION). Synonyms: supinatio (TA). Origin of term: Latin *supinus* = lying on the back.

Supraclavicular fossa (SOO-prah-klah-VICK-yoo-lar FOSS-ah). The lower portion of the depression in the skin known as the POSTERIOR TRIANGLE of the shoulders. Synonyms: fossa supraclavicularis major (TA), supraclavicular triangle, greater supraclavicular fossa. Origin of term: Latin *supra* = above + *clavicula* = a little key + *fossa* = ditch, trench.

Supraglenoid tubercle (su-pra-GLEN-oyd TOO-ber-kel). An ATTACHMENT site for the long HEAD of the BICEPS BRACHII muscle that is located directly above the GLENOID FOSSA of the SCAPULA. Synonyms: tuberculum supraglenoidale (TA), supraglenoid tuberosity of the scapula, tuberositas supraglenoidalis. Origin of term: Latin *supra* = above + Greek *glenoeides,* from *glene* = socket of joint + *eidos* = resemblance + Latin *tuberculum* = a swelling or knob.

Supraspinatus (SOO-prah-spih-NAH-tuss *or* soo-prah-spy-NAY-tuss). A MUSCLE that ATTACHES above the SPINE OF THE SCAPULA. It assists in the ABDUCTION of the upper ARM, raising the arm away from the side of the TORSO. Synonym: musculus supraspinatis (TA). Origin of term: Latin *supra* = above, over + *spina* = thorn, spine.

Supraspinous fossa (su-pra-SPY-nuss FOSS-ah). The shallow depression above the SPINE OF THE SCAPULA for the SUPRASPINATUS muscle. Synonym: fossa supraspinata (TA). Origin of term: Latin *supra* = above +*spina* = thorn, spine + *fossa* = ditch, trench.

Suprasternal notch. *See* PIT OF THE NECK

Suture joint. Any of the saw-edged IMMOVABLE JOINTS of the SKULL. Synonym: sutra (TA). Origin of term: Latin *sutura* = a seam.

Symphysis (SIM-fih-siss). A slightly movable CARTILAGINOUS JOINT that usually occurs on the MEDIAL LINE of the BODY, such as the FIBROCARTILAGE discs of the VERTEBRAL COLUMN. Synonym: secondary cartilaginous joint. Origin of term: Greek *symphysis* = a growing together.

Synarthrosis (SIN-ar-THROH-siss). An immovable joint. It can have either fibrous or cartilaginous connective tissues.

Synchondrosis (sin-kon-DROH-siss). An immovable CARTILAGINOUS JOINT, such as the joint at the first COSTAL CARTILAGE (of a RIB) and STERNUM. Synonyms: synchondrodial joint, primary cartilaginous joint. Origin of term: Greek *syn* = together + *chondros* = cartilage + *osis* = condition.

Syndesmosis (SIN-dez-MOH-siss). A slightly movable FIBROUS JOINT in which the two BONES are positioned somewhat apart from each other and are connected by an elongated, fibrous CONNECTIVE TISSUE called the INTEROSSEOUS MEMBRANE. Examples include the interosseous membranes of the TIBIA and FIBULA bones of the lower leg and of the ULNA and RADIUS bones of the FOREARM. Origin of term: Greek *syndesmos* = a fastening.

Synergist muscle (SIN-er-jist). A MUSCLE that assists an AGONIST MUSCLE in performing a movement. Synonyms: assistor, secondary muscle. Origin of term: Greek *synergein* = to work together.

Synovial fluid (sih-NOH-vee-aul). A clear fluid, resembling egg white, that acts as a lubricant for SYNOVIAL JOINTS and is produced in the JOINT CAPSULE. Synonym: synovia (TA). Origin of term: Greek *syn* = together + Latin *ovum* = egg.

Synovial joint (sih-NOH-vee-ul). A freely movable JOINT within a JOINT CAPSULE that contains a SYNOVIAL MEMBRANE that produces SYNOVIAL FLUID. Synonyms: articulatio (TA), junctura synovialis (TA), diarthrosis (TA), diarthrodial joint, movable joint. Origin of term: Greek *syn* = together + Latin *ovum* = egg.

Synovial membrane (sih-NOH-vee-ul). A membrane of CONNECTIVE TISSUE that lines the inside of a JOINT CAPSULE. Synonyms: membrana synovialis (TA), synovial layer (TA), stratum synoviale (TA), synovium. Origin of term: Greek *syn* = together + Latin *ovum* = egg.

Talus bone (TAL-us *or* TAY-luss). A TARSAL BONE of the PROXIMAL ROW OF TARSAL BONES of the foot that ARTICULATES with the TIBIA and FIBULA of the lower LEG. Synonyms: astragulus, huckle bone. Origin of term: Latin *talus* = ankle bone.

Tarsal bones (TAR-sal). The collective name for the seven bones surrounding the ankle region of the foot, including the heel. They are the CALCANEUS, TALUS, NAVICULAR, the three CUNEIFORM bones, and the CUBOID. Synonyms: ossa tarsi (TA, pl.), ossa tarsalia (TA, pl.), os tarsale (sing.). tarsale. Origin of term: Late Latin *tarsus* = instep.

Teeth. *See* TOOTH/TEETH

Temporal bone (TEM-poor-ral). Either of the two BONES forming the LATERAL (outer) walls of the CRANIUM. Synonyms: os temporale (TA), ossa temporalia, ossa temporalis, temple bone. Origin of term: Latin *temporalis* = belonging to the temples.

Temporalis (TEM-poor-AL-liss *or* TEM-poh-RA-liss). A fan-shaped MUSCLE located on the side of the CRANIUM on the temporal fossa. It helps ELEVATE the MANDIBLE in the action of closing a dropped jaw and assists in the RETRACTION of the mandible. Synonyms: musculus temporalis (TA), temporal muscle. Origin of term: Latin *temporalis* = belonging to the temples.

Temporary cartilage. CARTILAGE that is eventually replaced by BONE tissue in the OSSIFICATION process. Synonym: precursory cartilage.

Temporo-mandibular joint, or **TMJ** (TEM-puh-roh-man-DIB-yoo-lar). The HINGE JOINT between the lower jaw (MANDIBLE) and the TEMPORAL BONE of the SKULL. It is the only movable JOINT of the skull. Synonyms: articulatio temporomandibularis (TA), mandibular joint. Origin of term: Latin *temporalis* = belonging to the temples + *mandibula* = lower jawbone.

Tendon (TEN-din). A CONNECTIVE TISSUE of bands or cords that connect MUSCLE to BONE. Synonym: tendo (TA), sinew. Origin of term: Latin *tendere* = to stretch, to extend.

Tensor fascia latae (TEN-sor FASH-ee-uh LAH-tee *or* TEN-sor FASH-ee-uh LAY-tee *or* TEN-sor FASH-ee-uh LAT-tee *or* TEN-sor FASH-ee-uh LAA-tuh). The tear-shaped MUSCLE of the GLUTEAL GROUP that inserts into the ILIO-TIBIAL TRACT. It assists in the ABDUCTION of the THIGH and stabilizes the KNEE JOINT by making the ILIO-TIBIAL TRACT taut. Synonyms: musculus tensor fascia latae (TA), tensor of fascia latae, tensor fascia femoris, TFL. Origin of term: Latin *tensor*, from *tendere* = to stretch + *fascia* = band or fillet + *latae* = broad, wide.

Teres major (teh-REEZ MAY-jur). A cylindrical MUSCLE that ATTACHES on the SCAPULA. It ADDUCTS the upper ARM, pulling the arm from a horizontal position back to the side of the TORSO, and assists in the MEDIAL ROTATION and EXTENSION of the upper arm. Synonym: musculus teres major (TA). Origin of term: Latin *terez* = round + *major* = greater.

Teres minor (teh-REEZ MY-nur). The small round MUSCLE of the SCAPULA. It assists the INFRASPINATUS muscle in the LATERAL ROTATION of the HUMERUS. Synonym: musculus teres minor (TA). Origin of term: Latin *terez* = round + *minor* = lesser.

Thenar crease (THEE-nar). A crease on the palm of the HAND that curves around the outside of the THENAR GROUP of muscles (or thumb EMINENCE). Synonyms: life line, palmar skin fold of thumb eminence, fold of the thumb, line of the thumb. Origin of term: Greek *thenar* = palm.

Thenar group (THEE-nar). The MUSCLE GROUP at the base of the THUMB that creates the prominent form of the thumb EMINENCE. Synonyms: eminentia thenaris (TA), thenar, thenar eminence. Origin of term: Greek *thenar* = palm.

Thigh. In anatomical terminology, the upper leg, extending from the HIP JOINT to the KNEE JOINT. Synonyms: upper leg, femur bone.

Thoracic arch (thor-ASK-ik *or* thoh-RAS-ik). The arching ANTERIOR structure of the RIBCAGE, created by the COSTAL CARTILAGE of RIBS 7–10. Synonyms: arcus costalis (TA), costal arch, ribcage arch, costal margin, skeletal arch, anatomical arch, infrasternal angle. Origin of term: Greek *thorax* = chest.

Thoracic vertebrae (thor-ASK-ik VER-teh-bree *or* thoh-RAS-ik VER-teh-bray). The twelve VERTEBRAE of the THORAX, or RIBCAGE. Synonyms: vertebrae thoracicae (TA), dorsal vertebrae, vertebrae thoracales, TI–TXII. Origin of term: Greek *thorax* = chest + Latin *vertebra*, from *verto* = to turn.

Thorax (THOR-raks). The oval-shaped structure of the RIBCAGE, consisting of the RIBS, STERNUM, THORACIC VERTEBRAE, and COSTAL CARTILAGES. Synonyms: cavea thoracis (TA), ribcage, thoracic cage, thoracic basket. Origin of term: Greek *thorax* = chest.

Thumb. The opposable first DIGIT of the hand, which unlike the fingers consists only of two JOINTS. Synonyms: pollex (TA), digitus primus I (TA), I digit.

Thumb group. A MUSCLE GROUP composed of three deep-layer extrinsic muscles of the THUMB that attach on the FOREARM and insert into the bones of the thumb. The ABDUCTOR POLLICIS LONGUS, EXTENSOR POLLICIS BREVIS, and EXTENSOR POLLICIS LONGUS belong to this group.

Thyroid cartilage. The largest cartilage in the LARYNX, which includes the LARYNGEAL PROMINENCE (Adam's apple). Synonyms: cartilagio thyroidea (TA), cartilago thyreoidea. Origin of term: Greek *thyreos* = an oblong shield + *eidos* = resemblance + Latin *cartilago* = gristle.

Thyroid gland. A gland positioned on both sides of the upper part of the TRACHEA in the front of the neck. Synonym: glandula thyroidea (TA). Origin of term: Greek *thyreos* = an oblong shield + *eidos* = resemblance.

Tibia (TIB-ee-ah). The larger of the two BONES of the lower LEG; commonly known as the shinbone. Synonym: shin. Origin of term: Latin *tibia* = shinbone.

Tibialis anterior (tib-ee-AL-lis an-TEER-ee-or). A MUSCLE of the lower LEG that is positioned on the ANTERIOR side of the TIBIA. Its main function is to help lift the front part of the foot upward in the movement of DORSIFLEXION. Synonyms: musculus tibialis anterior (TA), tibialis anticus, shin musclè, muscle of the shin, anterior tibial muscle. Origin of term: Latin *tibia* = shinbone + *anterior* = front.

Tibial tuberosity (TIB-ee-ul TOO-burr-OSS-ih-tee). An obvious bony bump located on the upper ANTERIOR portion of the TIBIA between the lateral and medial CONDYLES. The PATELLAR LIGAMENT attaches here. Synonyms: tuberositas tibiae (TA), tuberosity of tibia, tubercle of tibia. Origin of term: Latin *tibia* = shinbone + *turberosus* = full of bumps.

Tip of the nose. A ball-like shape, created by CARTILAGE, between the two WINGS OF THE NOSE and NOSTRILS. Synonyms: apex nasi (TA), ball of nose, apex of nose.

Tooth/teeth. A tooth is a structure composed of DENTIN and covered in ENAMEL. It is rooted in a tooth socket (ALVEOLUS) in one of the two DENTAL ARCHES. There are four kinds of teeth: CANINES, INCISORS, MOLARS, and PREMOLARS. Synonym: dens (TA, sing.), dentes (TA, pl.).

Tooth socket. *See* ALVEOLUS

Torso. The central part of the body, including the RIBCAGE and PELVIS region but excluding the head and limbs. Synonyms: truncas (TA), trunk.

Trachea (TRAY-kee-ah). The windpipe; located in the neck, it extends from the LARYNX into the THORAX. Origin of term: Greek *tracheia arteria* = rough artery.

Tracheal cartilages (TRAY-kee-al). Ring-like CONNECTIVE TISSUE structures that form the windpipe (TRACHEA). Synonyms: cartilagines tracheales (TA), tracheal rings.

Tragus (TRAY-gus). A cartilaginous flap that acts as a protective shield over the ear hole leading into the ear canal (EXTERNAL AUDITORY MEATUS). Origin of term: Greek *tragos* = goat.

Transverse. Lying across or at a right angle to the long AXIS of the BODY. Origin of term: Latin *transversus* = crosswise, turned across.

Transverse arch of the foot. The arch of the foot that spans the width of the foot, running perpendicular to the LATERAL LONGITUDINAL ARCH and MEDIAL LONGITUDINAL ARCH. Synonym: arcus pedis transversalis. Origin of term: Latin *transversus* = crosswise, turned across.

Transverse intersections. Fibrous bands that horizontally interrupt the MUSCLE FIBERS of the RECTUS ABDOMINIS muscle. Synonyms: intersectiones tendineae (TA), transverse lines, tendinous intersections, tendinous inscription, linea transversae. Origin of term: Latin *transversus* = crosswise, turned across.

Transverse plane. The ANATOMICAL PLANE that divides the BODY horizontally, separating it into upper (SUPERIOR) and lower (INFERIOR) portions. Synonyms: plana transversalia (TA), horizontal plane, axial plane, transaxial plane, cross-sectional plane, cross, cross section. Origin of term: Latin *transversus* = crosswise, turned across.

Transverse process. Either of two protrusions (PROCESSES) of BONE on either side of the vertebral arch on a VERTEBRA. Synonym: processus transversus (TA). Origin of term: Latin *transversus* = crosswise, turned across.

Trapezium bone (traa-PEA-zee-yum). A CARPAL BONE of the DISTAL ROW OF CARPAL BONES of the wrist region. Synonyms: os trapezium (TA), greater multangular bone, major multangular bone, os multangulum majus. Origin of term: Greek *trapezion* = irregular four-sided shape.

Trapezius (traa-PEA-zee-us). A diamond-shaped MUSCLE located on the back of the upper RIBCAGE that creates the shoulder forms, the back of neck, and the muscular forms of the upper back. It has three portions: the descending (superior) part, the transverse (middle) part, and the ascending (inferior) part. Its main function is to move the SCAPULA bones in the actions of ELEVATION, ADDUCTION, and upward ROTATION. It also assists in the EXTENSION of the neck. Synonyms: musculus trapezius (TA), musculus cucullaris, cucullaris muscle, cucullary muscle, cowl muscle, "traps." Origin of term: Greek *trapezion* = irregular four-sided shape.

Trapezoid bone (TRAP-eh-zoyd). A CARPAL BONE of the DISTAL ROW OF CARPAL BONES of the wrist region. Synonyms: os trapezoideum (TA), minor multangular, lesser multangular, os multangulum minus. Origin of term: Greek *trapezoeides* = shaped like a trapezoid.

Triceps brachii (TRI-seps BRAY-kee-ee *or* TRI-seps BRAKE-ee-eye). The three-headed muscle of the POSTERIOR side of the upper ARM. Its three HEADS are the lateral head, the medial head, and the long head. The muscle's primary action is to EXTEND the FOREARM. The long head also assists in the ADDUCTION of the whole arm and in stabilizing the SHOULDER JOINT. Synonyms: musculus triceps brachii (TA), triceps extensor cubitus, triceps. Origin of term: Latin *tri* = three + *ceps* = head + *brachii* = of the arm.

Triceps surae (TRI-seps SOO-ree). The two-headed GASTROCNEMIUS muscle and the single-headed SOLEUS muscles of the lower LEG, considered by some anatomists to be one three-headed MUSCLE because the gastrocnemius and soleus share a common TENDON. Synonyms: musculus triceps surae (TA), triceps of the calf. Origin of term: Latin *tri* = three + *ceps* = head + *sura* = calf of the leg.

Triquetral bone (tri-KWEE-trul). A CARPAL BONE of the PROXIMAL ROW OF CARPAL BONES of the wrist region. Synonyms: os triquetrum (TA), triquetrum, triangular bone, cuneiform, pyramidal bone, os pyramidale. Origin of term: Latin *triquetrus* = three-cornered, triangular.

Trochanter (troh-KAN-ter). Either of two rough projections on the upper portion of the FEMUR bone of the THIGH. Origin of term: Greek *trochanter* = runner. *See also* GREATER TROCHANTER OF THE FEMUR, LESSER TROCHANTER OF THE FEMUR

Trochlea of the humerus (TROCK-lee-uh). A spool-shaped bone feature on the lower end of the HUMERUS that articulates with the TROCHLEAR NOTCH OF THE ULNA. Synonym: trochlea humeri (TA). Origin of term: Greek *trochileia* = pulley.

Trochlear notch of the ulna (TROCK-lee-ar). A large C-shaped structure on the upper end of the ULNA that ARTICULATES with the TROCHLEA OF THE HUMERUS to create a HINGE JOINT. Synonyms: incisura trochlearis (TA), greater sigmoid notch, incisura semilunaris, semilunar notch, greater sigmond cavity. Origin of term: Greek *trochileia* = pulley.

True ribs. The first seven pairs of RIBS of the RIBCAGE, whose COSTAL CARTILAGES connect directly into the STERNUM. Synonyms: costae verae (TA), I–VII. *Compare* FALSE RIBS, FLOATING RIBS

Trunk. Another name for the TORSO—the region of the RIBCAGE and PELVIS without the head or limbs. Synonym: truncus (TA).

Tubercle (TOO-burr-kul). A slight bump on the surface of a BONE for the ATTACHMENT of a TENDON or LIGAMENT. Synonyms: tuberculum (TA, sing.), tubercula (pl.). Origin of term: Latin *tuberculum* = a swelling or knob.

Tuberosity (TOO-burr-OSS-ih-tee). A large rounded projection on the surface of a BONE that is sometimes rough in texture and that serves as an ATTACHMENT site for a TENDON or LIGAMENT. Synonym: tuberositas (TA). Origin of term: Latin *turberosus* = full of bumps.

Ulna (ULL-nah). One of the two BONES of the FOREARM. (The other is the RADIUS.) The ulna is positioned on the LITTLE FINGER side of the HAND when the arm is in the ANATOMICAL POSITION. Synonyms: cubitus, lower arm bone (along with the radius). Origin of term: Latin *ulna* = elbow.

Ulna furrow. A furrow between the FLEXOR CARPI ULNARIS and EXTENSOR CARPI ULNARIS muscles on the ULNA bone of the FOREARM. It is positioned along the *posterior border of the ulna*. Synonyms: margo posterior (TA), ulna crest, posterior border, margo dorsalis, crest of ulna.

Ulnar (ULL-nar). Pertaining to the ULNA bone of the FOREARM.

Ulnar adduction. A movement in which the HAND leans sideways from the wrist toward the ULNA bone. Synonym: ulnar deviation.

Uniaxial joint. A JOINT that can move in only one ANATOMICAL PLANE.

Unipennate muscle fiber (yoo-nee-PEN-ate). Muscle fiber arrangement in which the MUSCLE FIBERS are attached at an OBLIQUE angle along just one side of a TENDON. Synonyms: musculus semipennatus (TA), musculus unipennatus (TA), semipennate, semipenniform. Origin of term: Latin *unus* = one, single + *penna* = feather.

Upper arm. *See* ARM

Upper limb. The shoulder, upper ARM, elbow, FOREARM, wrist, and HAND, considered as a unit. Synonym: upper extremity.

Vastus intermedius (VAS-tus in-ter-ME-dee-us). A MUSCLE of the QUADRICEPS GROUP that is located between the VASTUS LATERALIS and VASTUS MEDIALIS and positioned underneath the RECTUS FEMORIS. It assists in the EXTENSION of the lower LEG at the KNEE JOINT. Synonyms: musculus vastus intermedius (TA), crureus. Origin of term: Latin *vastus* = of large extent + *intermedius* = in between.

Vastus lateralis (VAS-tus laa-ter-AL-iss). A MUSCLE of the QUADRICEPS GROUP that is located on the outer region of the FEMUR. It assists in the EXTENSION of the lower LEG at the KNEE JOINT. Synonyms: musculus vastus lateralis (TA), vastus externus. Origin of term: Latin *vastus* = of large extent + *lateralis* of the side.

Vastus medialis (VAS-tus mee-dee-AL-iss). A MUSCLE of the QUADRICEPS GROUP that is located on the inner region of the FEMUR. The upper fibers of the muscle help EXTEND the LEG at the KNEE JOINT, while the lower fibers help stabilize the PATELLA. Synonyms: musculus vastus medialis (TA), vastus internus. Origin of term: Latin *vastus* = of large extent + *medialis* = of the middle.

Vermilion border of the lips. The reddish margin of the upper and lower LIPS of the ORBICULARIS ORIS muscle. (The lips, however, can have many hues, ranging from light pink to deep brown). Synonyms: red lip borders, red margin of the lips, rosy border.

Vertebra (VER-teh-brah)/ **vertebrae** (VER-teh-bray *or* VER-teh-bree). Singular and plural forms, respectively, for the bony components of the VERTEBRAL COLUMN. Origin of term: Latin *vertebra,* from *verto* = to turn.

Vertebral arch (VER-teh-bral). The arch-like shape projecting from the drum-like body of an individual VERTEBRA. Synonyms: arcus vertebrae (TA), neural arch.

Vertebral border of the scapula. The border of the SCAPULA bone that is closer to the VERTEBRAL COLUMN. Synonyms: margo medialis (TA), medial border of scapula, margo vertebralis, internal border.

Vertebral column. The backbone or spine, which is composed of the twenty-four individual VERTEBRAE, including the SACRUM and COCCYX, stacked on top of each other to form a curving column. Synonyms: columna vertebralis (TA), spinal column, rachis, spina.

Vertebra prominens (VER-teh-brah PROM-ih-nens). The SPINOUS PROCESS of the SEVENTH CERVICAL VERTEBRA, which creates a prominent bump on the surface form of the back of the neck. Synonyms: seventh vertebra, C7, C VII, prominent vertebra of the neck. Origin of term: Latin *vertebra,* from *verto* = to turn + *prominens* = a projection.

Vertical cleft of buttocks. *See* GLUTEAL CLEFT

Volar skin (VOH-lar). The very thick skin of the palm of the HAND and the PLANTAR SIDE OF THE FOOT. Volar skin contains sweat glands but is hairless. It protects the palms and soles from pressure and friction. Origin of term: Latin VOLAR = palm of hand, sole of foot.

Vomer bone (VOH-mer). A bone of the SKULL that forms the back and lower part of the NASAL SEPTUM. Origin of term: Latin *vomer* = plowshare.

Wing of the nose. Fibrous CONNECTIVE TISSUE forming the outer side shape surrounding each NOSTRIL. Synonyms: ala nasi (TA), ala of nose.

Wrist bones. The eight CARPAL BONES that form the wrist area. Synonyms: ossa carpi (TA), ossa carpalia (TA).

Wrist creases. Small horizontal creases in the skin occurring along the wrist on the ANTERIOR side of the ARM. Synonyms: bracelets, rasceta.

Wrist joint. The SYNOVIAL JOINT located between the lower end of the RADIUS bone and the PROXIMAL ROW OF CARPAL BONES (but not including the PISAFORM BONE). Synonyms: articulatio radiocarpalis (TA), radial carpal joint, radiocarpal articulation, articulatio radiocarpea, carpal joint.

Xiphoid process of the sternum (ZIH-foyd). The swordlike CARTILAGE that protrudes from the lower end of the STERNUM. Synonyms: processus xiphoideus (TA), xiphi-sternum, xiphoid cartilage, xiphoid appendix, ensiform process, metasternum, process ensiformis. Origin of term: Greek *xiphos* = swordlike.

Zygomatic arch (zigh-go-MAT-ik). The archlike structure on the side of the SKULL created by the temporal PROCESS of the ZYGOMATIC BONE and the zygomatic process of the TEMPORAL BONE. Together, these processes form a bridge of BONE that serves as an ATTACHMENT site for MUSCLES. Synonyms: arcus zygomaticus (TA), zygoma. Origin of term: Greek *zygoma* = yoke.

Zygomatic bone (zigh-go-MAT-ik). Either of the prominent FACIAL BONES that form the cheekbones. Synonyms: os zygomaticum (TA), jugal bone, mala, malar bone, zygoma, yoke bone. Origin of term: Greek *zygoma* = yoke.

Zygomaticus major (zigh-go-MAT-ick-us MAY-jur *or* zigh-go-MAT-ik-kus MAY-jur). An elongated band of MUSCLE that begins at the cheekbone (ZYGOMATIC BONE) and obliquely inserts into the corner of the mouth (MODIOLUS). The two zygomaticus major muscles elevate the corners of the mouth to produce the expression of smiling. Synonyms: musculus zygomaticus major (TA), greater zygomaticus, zygomaticus, smile muscle. Origin of term: Greek *zygoma* = yoke + Latin *major* = greater.

Zygomaticus minor (zigh-go-MAT-ick-us MY-nur *or* zigh-go-MAT-ik-kus MY-nur), A small, slender MUSCLE that attaches on the cheekbone (ZYGOMATIC BONE) and inserts into skin of the upper LIP. The two zygomaticus minor muscles help elevate the corners of the mouth. Synonyms: musculus zygomaticus minor (TA), lesser zygomaticus, zygomatic head of the quadratus labii superioris muscle group, caput zygomaticus. Origin of term: Greek *zygoma* = yoke + Latin *minor* = lesser.

Suggested Reading

Artistic Anatomy

Goldfinger, Eliot. *Human Anatomy for Artists: The Elements of Form.* New York: Oxford University Press, 1991.

Gordon, Louise. *How to Draw the Human Figure: An Anatomical Approach.* New York: Penguin, 1980.

Gordon, Louise. *How to Draw the Human Head: Techniques and Anatomy.* New York: Penguin, 1983.

Gordon, Louise. *The Figure in Action: Anatomy for Artists.* London: B. T. Batsford, 2003.

Hale, Robert Beverly, and Terence Coyle. *Albinus on Anatomy.* New York: Dover, 1989.

Hale, Robert Beverly, and Terence Coyle. *Anatomy Lessons from the Great Masters.* New York: Watson-Guptill, 2000.

Lutz, E. G. *Practical Art Anatomy.* Huddersfield, U.K.: Jeremy Mills, 2007.

Patterson, A. Melville. *Duval's Artistic Anatomy.* London: Cassel and Company, 1916.

Peck, Stephen Rogers. *Atlas of Human Anatomy for the Artist.* New York: Oxford University Press, 1982.

Richer, Paul. *Artistic Anatomy.* New York: Watson-Guptill, 1986.

Rubins, David K. *The Human Figure: An Anatomy for Artists.* New York: Penguin, 1975.

Saunders, J. B. de C. M., and Charles D. O'Malley. *The Illustrations from the Works of Andreas Vesalius of Brussels. With Annotations and Translations, a Discussion of the Plates and Their Background, Authorship, and Influence, and a Biographical Sketch of Vesalius.* Cleveland: World Publishing, 1950.

Schider, Fritz. *An Atlas of Anatomy for Artists.* 3rd ed. New York: Dover, 1957.

Simblet, Sarah. *Anatomy for the Artist.* New York: Dorling Kindersley, 2001.

Stanley, Diane. *Anatomy for Artists.* New York: Dover, 2003.

Thompson, Arthur. *A Handbook of Anatomy for Art Students.* 5th ed. New York: Dover, 1964.

Figure Drawing and Sculpting

Aristides, Juliette. *Classical Drawing Atelier: A Contemporary Guide to Traditional Studio Practice.* New York: Watson-Guptill, 2006.

Berry, William A. *Drawing the Human Form: Methods, Sources, and Concepts: A Guide to Drawing from Life.* New York: Van Nostrand Reinhold, 1977.

Burban, Michael. *Lessons from Michelangelo: Figure Drawing Based on Techniques of the Master.* New York: Watson-Guptill, 1986.

Goldstein, Nathan. *Figure Drawing: The Structure, Anatomy, and Expressive Design of Human Form.* 5th ed. Englewood Cliffs, N.J.: Prentice Hall, 1998.

Hale, Robert Beverly. *Drawing Lessons from the Great Masters: 100 Great Drawings Analyzed, Figure Drawing Fundamentals Defined.* New York: Watson-Guptill, 1989.

Hale, Robert Beverly. *Master Class in Figure Drawing* (25th Anniversary Edition). New York: Watson-Guptill, 1991.

Hamm, Jack. *Drawing the Head and Figure.* New York: Perigee Trade, 1982.

Hoffman, Malvina. *Heads and Tales.* New York: Charles Scribner's Sons, 1936.

Hoffman, Malvina. *Sculpture Inside and Out.* New York: Bonanza, 1939.

Lanteri, Edouard. *Modelling and Sculpting the Human Figure.* New York: Dover, 1985.

Loomis, Andrew. *Drawing the Head and Hands.* New York: Viking, 1956.

Loomis, Andrew. *Figure Drawing for All It's Worth.* New York: Viking, 1971.

Lucchesi, Bruno, and Margit Malmstrom. *Modeling the Figure in Clay: A Sculptor's Guide.* New York: Watson-Guptill, 1996.

Maughan, William L. *The Artist's Complete Guide to Drawing the Head.* New York: Watson-Guptill, 2004.

Mendelowitz, Daniel, David L. Faber, and Duane A. Wakeham. *A Guide to Drawing.* 7th ed. Belmont, Calif.: Wadsworth, 2006.

Nelson, Craig. *The Drawing Bible.* Cincinnati: North Light Books, 2006.

Reed, Walt. *The Figure: The Classic Approach to Drawing and Construction.* Cincinnati: North Light Books, 1984.

Ryder, Anthony. *The Artist's Complete Guide to Figure Drawing: A Contemporary Perspective on the Classical Tradition.* New York: Watson-Guptill, 2000.

Vanderpoel, John H. *The Human Figure: Life Drawing for Artists.* 2nd revised ed. New York: Dover, 1958.

Vilppu, Glenn V. *Vilppu Drawing Manual.* Acton, CA: Vilppu Studio Press, 1997.

Yan, Henry. *Henry Yan's Figure Drawing: Techniques and Tips.* N.p.: Aardvark Global Publishing, 2006.

History of Figurative Art/Masters of Figurative Art

Ames-Lewis, Francis. *The Draftsman Raphael.* New Haven, Conn.: Yale University Press, 1986.

Ames-Lewis, Francis. *Drawing in Early Renaissance Italy.* New Haven, Conn.: Yale University Press, 2000.

Ames-Lewis, Francis, and Joanne Wright. *Drawing in the Italian Renaissance Workshop.* London: Victoria and Albert Museum, 1983.

Bambach, Carmen C., ed. *Leonardo da Vinci, Master Draftsman.* New York: Metropolitan Museum of Art, 2003.

Brown, Christopher. *The Drawings of Anthony van Dyck.* New York: Pierpont Morgan Library, 1991.

Clayton, Martin. *Raphael and His Circle: Drawings from Windsor Castle.* London: Merrell Holberton, 1999.

Davenport, Guy. *The Drawings of Paul Cadmus.* New York: Rizzoli, 1989.

Descharnes, Robert, and Jean-François Chabrun. *Auguste Rodin.* New York: Viking, 1967.

De Tolnay, Charles, and Paolo Barocchi. *Drawings of Michelangelo: 103 Drawings in Facsimile.* New York: George Braziller, 1965.

Elderfield, John. *The Language of the Body: Drawings by Pierre-Paul Prud'hon.* New York: Harry N. Abrams, 1996.

Knox, George. *Piazzetta: A Tercentenary Exhibition of Drawings, Prints, and Books.* Washington, D.C.: National Gallery of Art, 1983.

Koschatzky, Walter, and Alice Strobl. *Dürer Drawings in the Albertina.* Greenwich, Conn.: New York Graphic Society, 1972.

Koschatzky, Walter, Konrad Oberhuber, and Eckhart Knab, eds. *Italian Drawings in the Albertina.* Greenwich, Conn.: New York Graphic Society, 1971.

LeBooy, Paul James. *Michelangelo Models Formerly in the Paul von Praun Collection.* Vancouver: Creelman & Drummond, 1972.

Meij, A. W. F. M. *Rubens, Jordaens, Van Dyck, and Their Circle: Flemish Master Drawings from the Museum Boijmans van Beuningen.* Rotterdam: NAI, 2001.

Nigro, Salvatore S. *Pontormo: Drawings.* New York: Harry N. Abrams, 1992.

Olszewski, Edward J. *The Draftsman's Eye: Late Italian Renaissance Schools and Styles.* Cleveland: Cleveland Museum of Art/Indiana University Press, 1981.

Paris, Reine-Marie. *Camille: The Life of Camille Claudel, Rodin's Muse and Mistress.* New York: Henry Holt, 1988.

Pignatti, Terisio. *Master Drawings from Cave Art to Picasso.* Seacaucus, N.J.: Wellfleet Press, 1989.

Reich, Sheldon. *Francisco Zuñiga, Sculptor: Conversations and Interpretations.* Tucson: University of Arizona Press, 1980.

Rowlands, John. *Master Drawings and Watercolours in the British Museum.* London: British Museum Publications, 1984.

Spring, Justin. *Paul Cadmus: The Male Nude.* New York: Universe, 2002.

Tofani, Annamaria Petrioli, and Graham Smith. *Sixteenth-Century Tuscan Drawings from the Uffizi.* New York: Oxford University Press, 1988.

Turner, Nicholas. *Florentine Drawings of the Sixteenth Century.* London: British Museum Press, 1986.

Watrous, James. *The Craft of Old-Master Drawings.* Madison, Wis.: University of Wisconsin Press, 2002.

Zöllner, Frank. *Leonardo da Vinci, 1452–1519: Sketches and Drawings.* Cologne: Taschen, 2004.

Medical Anatomy—Books

Anson, Barry J. *An Atlas of Human Anatomy.* 2nd ed. Philadelphia: W. B. Saunders, 1963.

Backhouse, Kenneth M., and Ralph T. Hutchings. *Color Atlas of Surface Anatomy: Clinical and Applied.* Baltimore: Williams & Wilkins, 1986.

Clemente, Carmine D. *Anatomy: A Regional Atlas of the Human Body.* Philadelphia: Lippincott Williams & Wilkins, 2006.

Crouch, James E. *Functional Human Anatomy.* 4th ed. Philadelphia: Lippincott Williams & Wilkins, 1985.

Drake, Richard L., Wayne Vogl, and Adam W. M. Mitchell. *Gray's Anatomy for Students.* Philadelphia: Churchill Livingstone, 2005.

Gray, Henry. *Anatomy: Descriptive and Surgical.* Edited by T. Pickering Pick and Robert Howden. Ann Arbor, Mich.: Border's Classics, 2003.

von Hagens, Gunther, and Angelina Whalley. *Body Worlds: The Anatomical Exhibition of Real Human Bodies.* Singapore: Art & Sciences, 2006.

Jackson, C. M., ed. *Morris' Human Anatomy*. 9th ed. Philadelphia: Blakiston, 1933.
Kapandji, I. A. *The Physiology of the Joints, Volume One: Upper Limb.* 6th ed. Edinburgh: Churchill Livingstone, 2007.
Kapandji, I. A. *The Physiology of the Joints, Volume Two: Lower Limb.* 5th ed. Edinburgh: Churchill Livingstone, 1987.
Kapandji, I. A. *The Physiology of the Joints, Volume Three: The Vertebral Column, Pelvic Girdle, and Head.* 6th ed. Edinburgh: Churchill Livingston, 2008.
McMinn, R. M. H., R. T. Hutchings, J. Pegington, and P. H. Abrahams. *A Color Atlas of Human Anatomy.* Chicago: Mosby-Year Book, 1983.
Moore, Keith L., and Arthur F. Dalley. *Clinically Oriented Anatomy*. 5th ed. Philadelphia: Lippincott Williams & Wilkins, 2006.
O'Loughlin, Valerie, and Michael McKinley. *Human Anatomy.* New York: McGraw-Hill, 2006.
Parker, Steve. *Skeleton.* New York: Alfred A. Knopf, 1988.
Platzer, Werner. *Color Atlas and the Textbook of Human Anatomy: Volume I: Locomotor System.* New York: Thieme Medical Publishers, 1992.
Rohan, Johannes W., Chihiro Yokochi, and Elke Lutjen-Drecoll. *Color Atlas of Anatomy: A Photographic Study of the Human Body.* Philadelphia: Williams & Wilkins, 1998.
Stedman, Thomas Lathrop. *Stedman's Medical Dictionary: A Practical Medical Dictionary.* New York: William Wood & Co., 1911.
Stedman's Medical Dictionary. 28th ed. Philadelphia: Lippincott Williams & Wilkins, 2005.
Stedman's Medical Dictionary for Health Professions and Nursing. Philadelphia: Lippincott Williams & Wilkins, 2006.
Taber's Cyclopedic Medical Dictionary. 19th ed. Edited by Donald Venes, Clayton L. Thomas, and Clarence Wilbur Taber. Philadelphia: F. A. Davis, 2001.
Terminologia Anatomica: International Anatomical Terminology. New York: Theime Stuttgart, 1998.
Thibodeau, Gary A., and Kevin T. Patton. *Structure & Function of the Body*. 12th ed. St. Louis: Mosby, 2003.
Williams, Peter, and Roger Warwick. *Gray's Anatomy*. 37th ed. Edinburgh: Churchill Livingston, 1989.

Medical Anatomy—DVDs

Acland, Robert C. *Acland's DVD Atlas of Human Anatomy.* Series of six DVDs. Philadelphia: Lippincott Williams & Wilkins, 2003. A Web-based streaming version is also available.
Hillman, Susan K. *Interactive Functional Anatomy.* 2nd ed. London: Primal Pictures, 2006.

Kinesiology, Bodybuilding, and Dance

Calais-Germain, Blandine. *Anatomy of Movement.* Seattle: Eastland Press, 1993.
Calais-Germain, Blandine, and Andrée Lamotte. *Anatomy of Movement: Exercises.* Ed. by Stephen Anderson. Seattle: Eastland Press, 1996.
Clippinger, Karen. *Dance Anatomy and Kinesiology.* Champaign, Ill.: Human Kinetics, 2007.
Delavier, Frédéric. *Strength Training Anatomy*. 2nd ed. Champaign, Ill.: Human Kinetics, 2005.
Delavier, Frédéric. *Women's Strength Training Anatomy.* Champaign, Ill.: Human Kinetics, 2003.
Floyd, R. T., and Clem W. Thompson. *Manual of Structural Kinesiology*. 16th ed. New York: McGraw-Hill, 2006.
Oatis, Carol A. *Kinesiology: The Mechanics and Pathomechanics of Human Movement*. 5th ed. Philadelphia: Lippincott, Williams & Wilkins, 2004.
Palastanga, Nigel, Derek Field, and Roger Soames. *Anatomy and Human Movement: Structure & Function*. 5th ed. Edinburgh: Butterworth-Heinemann, 2006.

History of Anatomy

Ball, James, Moores. *The Body Snatchers: Doctors, Gravediggers and the Law.* New York: Dorset Press, 1989.
Brothwell, D. R. *Digging Up Bones: The Excavation Treatment and Study of Human Skeletal Remains.* Ithaca, N.Y.: Cornell University Press, 1981.
Brooke, Elisabeth. *Medicine Women: A Pictorial History of Women Healers.* Wheaton, Ill.: Quest Books, 1997.
Chewning, Emily Blair, and Dana Levy. *Anatomy Illustrated.* New York: Simon & Schuster, 1979.
Cohen, Daniel. *Body Snatchers.* New York: HarperCollins Children's Books, 1975.
Encylopædia Anatomica: A Collection of Anatomical Waxes. 25th ed. Cologne: Taschen, 2006.
Flynn, Tom. *The Body in Three Dimensions.* New York: Harry N. Abrams, 1998.
Haeger, Knut. *The Illustrated History of Surgery: A Unique Account of Surgery Through the Ages.* London: Harold Starke, 2000.
Henschen, Folke. *The Human Skull: A Cultural History.* Translated by Stanley Thomas. New York: Frederick A. Praeger, 1966.
Herrlinger, Robert. *History of Medical Illustration from Antiquity to 1600.* New York: Editions Medicina Rara, 1970.
Kemp, Martin, and Marina Wallace. *Spectacular Bodies: The Art and Science of the Human Body from Leonardo to Now.* Berkeley: University of California Press, 2000.
Lyons, Albert S., and R. Joseph Petrucelli II. *Medicine: An Illustrated History.* Revised ed. New York: Harry N. Abrams, 1997.
Mayor, A. Hyatt. *Artists and Anatomists.* New York: Artist Limited Edition (in association with the Metropolitan Museum of Art), 1984.
Petherbridge, Deanna, and Ludmilla Jordanove. *The Quick and the Dead: Artists and Anatomy.* Berkeley: University of California Press, 1998.
Reid, Lori. *The Art of Hand Reading.* London: Dorling Kindersley, 1996.
Rifkin, Benjamin A., and Michael J. Ackerman. *Human Anatomy (From the Renaissance to the Digital Age).* New York: Harry N. Abrams, 2006.
Roach, Mary. *Stiff: The Curious Lives of Human Cadavers.* New York: W. W. Norton, 2004.
Sappol, Michael. *Dream Anatomy.* Bethesda, Md.: National Institute of Health, 2006.
Walker, Barbara G. *The Women's Dictionary of Symbols and Sacred Objects.* New York: HarperOne, 1988.

The Face and Facial Expressions

Ekman, Paul. *Emotions Revealed: Recognizing Faces and Feelings to Improve Communication and Emotional Life.* New York: Holt, 2004.
Faigin, Gary. *The Artist's Complete Guide to Facial Expression*. New York: Watson-Guptill, 1990.
Landau, Terry. *About Faces.* New York: Doubleday, 1989.
Prag, John, and Richard Neave. *Making Faces; Using Forensic and Archaeological Evidence.* College Station, Texas: Texas A & M University Press, 1997.

Internet Resources

Visit the following website for anatomical charts, medical anatomy books and DVDs, and reproduction skeleton and skull models.

Anatomical Chart Company
www.anatomical.com

The following website offers beautiful, meticulously detailed écorché models by Andrew Cawrse as well as information on artist's anatomy workshops given by a variety of instructors.

Freedom of Teach
www.freedom-of-teach.com

Visit the following museum websites to view master life drawings, écorché studies, skeletal studies, and other examples of figurative art.

Art Institute of Chicago
www.artic.edu

Courtauld Institute of Art
www.courtauld.ac.uk

The Frick Collection
www.frick.org

J. Paul Getty Museum
www.getty.edu/museum

Metropolitan Museum of Art
www.metmuseum.org

The Morgan Library & Museum
www.morganlibrary.org

Museum of Fine Arts, Boston
www.mfa.org

National Gallery of Art
(Washington, D.C.)
www.nga.gov

National Library of Medicine
www.nlm.gov

The Royal Collection
www.royalcollection.org.uk

Index

Note: Page references in *italics* indicate illustrations.

A

Abdominal arch (Greek arch), 115
Abdominis: as muscle-name term, 276
Abduction (movement): of abductor muscles, 177, 190; of axilla (armpit), 151; on coronal plane, 29, 31, 32, 34, *34, 35,* 265; defined, 23; of deltoid muscles, 129; of extensor muscles, 173, 174; of femur bone, 202; of flexor muscles, 168; of gluteal muscles, 214, 215; of interosseous muscles, 192; joints and, 60; of limbs, *34, 35,* 139, 234; scapula-group muscles and, 143; of serratus anterior muscle, 137
Abductor digiti minimi muscle (foot): features of, 233–36, *235*; foot proportions and, 240; longitudinal arches and, 232
Abductor digiti minimi muscle (hand), 189, *191,* 273, 276
Abductor hallucis muscle: as abductor muscle, 273; illustrated, *235*; medial arch and, 234; toes and, 233
Abductor pollicis brevis muscle, 190, *190*
Abductor pollicis longus muscle: anatomical snuffbox and, 181; features of, 176, 177, *177*; movement of, 177; radius bone and, 157
Acetabulum, 121, 203, 208, 272
Achilles tendon. *See* Calcaneal tendon
Acromion (acrimonial process), 119, 141, 157
Action drawings, 244–48, *244–48,* 258, *258,* 259, *259*
Adam's apple. *See* Laryngeal prominence
Adduction (movement): of adductor muscles, 190, 211; of anconeus muscles, 165; on coronal plane, 29, 31, 32, 34, *34, 35,* 265; of extensor muscles, 176; of femur bone, 202; of flexor muscles, 170; of interosseous muscles, 192; joints and, 60; of limbs, *34, 35,* 127; of rhomboid muscles, 141; scapula-group muscles and, 143; of shoulders, 131
Adductor brevis muscle, 206, 211, 273, 274
Adductor longus muscle, 206, 211, 273, 274
Adductor magnus muscle, 206, 211, 273, 274
Adductor muscles: brevis, 206, 211, 273; features of, 210, *210,* 211; gracilis, 206, 211; longus, 206, 211, 273; magnus, 206, 211, 273; movement of, 211, *211*; pectineus, 206, 211; pollicis, 273
Adductor pollicis muscle, 190, 273, 276
Adipose tissue, 46, 47. *See also* Subcutaneous fat
Agonist muscles, 66, 67, 273
Alar cartilage, 41, 267
Anatomical center, 121
Anatomical directions/locations: anterior, 27, *30,* 31, 264; distal, *30,* 31, 264; dorsal, *30,* 31, 264; inferior, 29, 31, 264; lateral, 23, *30,* 31, 264; medial, 23, *30,* 31, 264; palmar, *30,* 31, 264; plantar, *30,* 31, 264; posterior, 27, *30,* 31, 264; proximal, *30,* 31, 264; superior, 29, 31, 264; volar, 31, 264
Anatomical position: anatomical directions and, 31; anatomical planes of, 28, *28*; of arms, 155, 157, 165, 172, 180; attributes of, 24, *24, 25*; of hands, 194
Anatomical science, 13–17. *See also* Dissections; Medical schools
Anconeus muscle, 164, *164,* 165
Angle of mandible, 74
Angles: central axis and, 244; drawing, 244–45; of fingers, 196; of legs, 219, 222; of mouth, 92; of torso, 149
Ankles, 272. *See also* Lateral malleolus; Medial malleolus
Annular ligament, 158
Antagonist muscles, 66, 67, 90, 273
Anterior: as direction/location term, 27, 31, 264; as muscle-name term, 275
Anterior compartment (thigh), 206
Anterior crest, 204
Anterior superior iliac spine. *See* ASIS
Anterior tarsal bones, 231
Anterior triangle (neck), 99
Antihelix, 107
Antitragus, 107
Aponeurosis: epicranial, 82; of muscles, 64, 82, 134, 135, 138; purpose of, 45, *45,* 267
Appendicular skeleton, 52, *52*
Arches of foot, 232, *232*
Arch of cricoid cartilage, 100
Arm: extensor muscles of, 172; flexor muscles of, 166; illustrated, *167*; pronator muscles of, 166; proportions of, 179, *179,* 180, 258; shapes of, 178; synovial sheaths of, 172. *See also* Bones of arm; Muscles of arm
Armatures (geometric): of body, 246, 248; defined, 149, *149*; of feet, 239; of ribcage and pelvis, 149; of torso, 144, 148
Armatures (organic): of body, 248; of feet, 239; of ribcage and pelvis, *149*; of torso, 144, *148*
Armatures (skeletal): 144, 148, *148, 149*
Arm movements: of anconeus muscle, 165; of biceps brachii muscle, 161; of brachioradialis muscle, 163; on coronal plane, *35*; of deltoid muscles, 129; joints and, 272; of latissimus dorsi muscle, 139; of pectoralis major muscle, 127; of pronator teres muscle, 171; of scapula muscles, 143; on transverse plane, *36*; of triceps brachii muscle, 165
Armpit. *See* Axilla
Art academies, 15, 19
Articular cartilage, 41, *41,* 267
ASIS (anterior superior iliac spine), 44, 120, 135, 144
Assael, Steven, 15
Atlas (vertebra of neck), 76, 113
Avicenna (Ibn Sina), 14, *14*
Axial skeleton, 52, *52*
Axilla (armpit), 151
Axis (vertebra of neck), 76
Axis of body. *See* Central axis

B

Back, 125. *See also* Torso
Ball-and-socket joints, 58, *59,* 60, 118; of hip/shoulder/arm, 272; humerus bone and, 157
Ball of foot, 231
Biaxial joint, 60
Biceps brachii muscle: as agonist muscle, 273; arm and, 157, 159; brachialis muscle and, 162; features of, 161, *161*
Biceps femoris muscle, 206, 212, 213, 276
Bicipital aponeurosis, 161
Bicipital groove, 161
Bipennate muscle fibers, 66, 192
Body: action studies of, 244–48, *244–48,* 258, *258,* 259, *259*; arm/hand proportions of, 258; central axis of, 244–45; ectomorph type, 261, *261*; 8-heads proportions for, 249, 250, *252,* 253, 260; endormorph type, 261, *261*; gesture drawings of, 244, *244–48*; heights of, 260, *261*; illustrated, *251*; leg/foot proportions of, 258; mesomorph type, 261, *261*; planes of, 246–47; proportions of, 255–58, *255, 256*; rhythms of, 262, *262*; 7½-heads proportions for, 249, 254, *255,* 260; structural shapes of, 246–48; widths of, 259
Body of sternum, 116
Body of vertebra (centrum), 113
Bones: as connective tissue, 49; depressions of, 268; features of, 49, 55, 268; openings of, 268; osseous tissue of, 49; projections of, 55, 268; shapes of, 53, *53,* 268; surface features of, *54,* 55. *See also* Skeleton
Bones of arm, 58–60, 154–58, 161, 162. *See also* Humerus bone; Radius bone; Ulna bone
Bones of face, 73–75, *73, 74,* 268, 270
Bones of foot, 228–31, *229–31,* 271
Bones of hand: capitate, 186, 271; carpal bone, 186; hamate, 186, 271; illustrated, *185*; joints and, *186,* 187; lunate, 186, 271; metacarpals, 186; phalanges, 186; pisaform, 186, 271; scaphoid, 186, 271; trapezium, 186, 271; trapezoid, 186, 271; triquetral, 186, 271
Bones of leg, 202–05, *202–04*
Bones of skull: cervical vertebrae, 76, *76*; cranium, 52, 73; ethmoid, 73; external occipital protuberance and, 73; facial, 73, 74; floor of, 73; frontal, 73, *73*; glabella, 73, *73*; illustrated, *71–74*; inferior nasal concha, 73; lacrimal, 73; mandible, 73, *74*; mastoid process, 73; maxilla, 73; nasal, 73; occipital, 73; palatine, 270; parietal, 73; sphenoid, 73; structure of, 70; superciliary arches and, 73; superior temporal lines and, 73; suture joints of, *56,* 57, 267, 272; teeth, 75, *75,* 76; temporal, 73; vault of, 73; vertebrae, 76, *76*; vomer, 73; zygomatic, 73, *73*; zygomatic arch, 73. *See also* Cranium
Bones of torso, 110–20
Brachialis muscle, 159, 162, *162,* 273, 276
Brachii/brachium: as muscle-name terms, 276
Brachio: as muscle-name term, 275
Brachioradialis muscle, 159; as agonist muscle, 273; brachialis muscle and, 162; extensor carpi radialis longus muscle and, 173; humerus bone and, 163; movement of, 163, *163*; pronator teres muscle and, 171; radial muscle and, 181; radius bone and, 163;
Brevis: as muscle-name term, 274
Bridge of nose. *See* Nose
Buccinator muscle, 92, *92*
Bursae, 224, 225

C

Cadavers, human, 17
Cadmus, Paul, 110
Calcaneal tendon (Achilles tendon), 219, 220
Calcaneal tuberosity, 230
Calcaneus bone, 219, 232, 234
Canine teeth, 76
Canons of proportions: 8-head system, 249, 250, *252,* 253; of foot, 240; halves in, *256,* 257; of head, 97, 98; of legs, 223, *223*; Leonardo da Vinci and, 249; 7½-head system, 249, 254, *255*; thirds in, 250, *256,* 257; of torso, 146, *146,* 147, *147*. *See also* Proportions

Capitulum of humerus, 157, 158
Caravaggio, 110
Cardiac muscles, 61
Carpal bones: and appendicular skeleton, 52; capitate, 186; distal row of, 186; hamate, 186; hook of hamate, 184; illustrated, *186*; interosseous ligaments and, 186; lunate, 186; pisaform, 184, 186; proximal row of, 186; scaphoid, 184, 186; as short bones, 53, 268; trapezium, 184, 186; trapezoid, 186; triquetral, 186
Carpo-metacarpal joint. *See* CMC joint
Carpus: as term, 276
Carrying angle (of arm), 180
Cartilage: costal, 115, 126, 132; of ears, 106; elastic, 106, 267; fibrocartilage, 42, *42,* 121, 205, 267; hyaline, 41, 267; of nose, 105
Cartilaginous joints, 56, 57, *57,* 272
Cassatt, Mary, 15
Central axis, 132, 133, 135; in drawing, 244, 245, 262; of head, 96, *96, 98*; illustrated, *27*; of thorax, 116; of torso, 144, *145,* 150, 151
Cervical vertebrae, 76, *76,* 113, 114
Chin, 75, 90, 91
Circular muscle fibers, 66, 67
Circumduction (movement): on all planes, 31, 37, 265; ball-and-socket joints and, 60; defined, 23; of femur bone, 202
Clavicles: deltoid muscle and, 128; illustrated, *117*; as long bones, 53, 268; movement of, 117; and neck, 99; of shoulder girdle, 52, 119; sternocleidomastoid muscle and, 94, 95; and sternum, 116; suprasternal notch of, 117; trapezius muscle and, 130
Clavicular head, 94
Cleido: as muscle-name term, 275
CMC joint (carpo-metacarpal joint), 187, 197
Coccyx bone, 23, 121
Colloquial terms for anatomical structures, 23
Compact bone tissue, 49
Compressor naris muscle, 85
Concha, 107
Condylar process, 74
Condyles of bones: of atlas vertebra, 76; of femur bone, 54, 202; function of, 55, 268; of tibia bone, 202, 204
Conjunctiva, 102
Connective tissues: aponeurosis, 45, *45,* 267; cartilage, 40, 267; fascia, 46, 267; fatty tissues, 40; and joints, 56; ligaments, 40, 43, *43,* 267; purpose of, 40; subcutaneous fat, 47, 267; tendons, 40, 45, *45,* 267
Contrapposto position, *26,* 27, 114, 206
Convergent muscle fibers, 66, 67
Cornea, 102
Coronal plane: defined, 264; features of, 28, *28, 29*; frontal plane and, 29; illustrated, *35, 39*; movement on, 31, 32, 34, *34,* 38, *39,* 265; synonyms for, 264
Coronoid process, 74, 119, 161, 171
Corrugator supercilii muscle, 83
Costal cartilage, 41, *41,* 267
Cranial floor, 73
Cranium: and axial skeleton, 52; ethmoid bone of, 73, 269; external auditory meatus of, 73; external occipital protuberance of, 73; flat bones of, 53, 268; frontal bone of, 73, *73,* 269; glabella of, 73, *73*; illustrated, *71–74*; nasion of, 73; occipital bone of, 73; orbital cavities of, 73; parietal bone of, 269; proportions, 49; sphenoid bone of, 73, 269; superciliary arches of, 73; superior temporal lines of, 73; temporal bone of, 269; temporalis muscle in, 81. *See also* Skull
Crest of bone, 55, 268
Cricoid cartilage, 100
Cubital fossa, 171, 180, *180*
Cuboid tarsal bones, 230–32, 271
Cuneiform tarsal bones, 230–32

D

Deep fascia, 267
de Lempicka, Tamara, 109
Delta; as muscle-name term, 274
Deltoid muscle: acromial portion of, 128–29; biceps brachii muscle and, 161; brachialis muscle and, 162; clavicular portion of, 127; as delta-shaped muscle, 274; deltoid tuberosity of, 128; features of, 128, *128,* 129, *129*; humerus bone and, 128, 157; infra-clavicular fossa and, 129; rotation movement of, 129, *129*; scapula and, 128, 143; spinal portion of, 128–29; trapezius muscle and, 128; triceps brachii muscle and, 165
Deltoid tuberosity, 128, 157
Dens of second cervical vertebra, 76
Dental arch, 74, 75
Depression (movement): defined, 266; of jaw, 38, *39*; of shoulders, 38, *39,* 118, 119
Depressor anguli oris muscle, 90, *90,* 273
Depressor labii inferioris muscle, 90, *91,* 273
Depressor muscles, 90, 273
Depressor supercilii muscle, 83, 85
Diaphysis of long bone, 53
Digastric muscle, 92, 93, *93*
Digiti: as muscle-name term, 276
Digitorum: as muscle-name term, 276
DIP joint (distal inter-phalangeal joint), 175, 187, 197
Dissections, 15–17. *See also* Anatomical science; Medical schools
Distal: as direction/location term, *30,* 31, 264
Distal digital crease, 197
Distal inter-phalangeal joint. *See* DIP joint
Distal phalanges, 175, 177, 218
Dorsal: as direction/location term, *30,* 31, 184, 264
Dorsal interosseous muscles, 192, 275
Dorsi: as muscle-name term, 275
Dorsiflexion (movement): on coronal plane, 38; extensor digitorum longus muscle and, 218; of foot/toes, *39,* 216, 231, 266; tibialis anterior muscle and, 216, 217
Double-jointedness, 59
Drawing: angles in, 244–45; central axis in, 244, 262; follow-through lines in, 262; poses in, 244–46, 262; proportions in, 246; structural shapes in, 247, 248; styles of, 246, 247; using planes, 246. *See also* Action drawings; Armatures (geometric); Armatures (organic); Armatures (skeletal); Canons; Proportions

E

Ear: antitragus of, 107; antihelix of, 107; canal of, 106; concha of, 107; elastic cartilage of, 42, 106, 267; features of, 107, *107*; helix of, 107; lobe of, 107; location of, 99; notch of, 107; ossicle bones of, 106; tragus of, 107
Ear canal, 106
Earlobes, 107
Ear notch, 107
Écorché drawings and models, *12,* 13, 15, 16, 19
Ectomorph body type, 261, *261*
Eight-heads proportional system, 249, 250, *252,* 253, 260
Elastic cartilage, 42, *42,* 121, 205, 267
Elbow: annular ligament and, 158; arm bones and, 157, 158; biceps brachii muscle and, 161; brachialis muscle and, 162; capitulum and, 158; epicondyles of, 158; humerus bone and, 158; illustrated, *158*; joints of, 58–60, 158, 272; movement of, *33,* 161; olecranon process and, 158; triceps brachii muscle and, 165; trochlea and, 158
Elevation (movement): defined, 266; of jaw, 38, *39*; of rhomboid muscles, 141; of shoulders, 38, *39,* 117–19, 131
Ellipsoid/condyloid joints, 58–60, *59,* 272
Endomorph body type, 261, *261*
Epicanthic fold, 102–03
Epicondyles, 54, 55, 156–58, 268
Epiphysis of long bone, 53
Erlebacher, Martha Mayer, 15
Ethmoid bone, 73, 104, 269
Eversion (movement), 38, *39,* 221, 266
Extension (movement): of abductor muscle, 177, 234; of adductor muscle, 211; of anconeus muscle, 165; of arm, 139; of deltoid muscle, 129; of extensor muscle, 173–77, 218, 236; of femur bone, 202; of gluteal muscle, 215; of joint, 60, 205, 224; of neck, 76, 131; of rectus femoris muscle, 209; of sacrospinalis muscle, 125; on sagittal plane, 29, 31–33, *32, 33,* 265; scapula muscle and, 143; of vastus muscle, 209; of vertebral column, 114
Extensor carpi radialis brevis muscle: of arm, 174; extensor carpi radialis longus muscle and, 174; as extensor muscle, 273; flexor carpi radialis muscle and, 168; movement of, 174, *174*
Extensor carpi radialis longus muscle: brachioradialis muscle and, 173; extensor carpi radialis brevis muscle and, 174; flexor carpi radialis muscle and, 168; as fusiform muscle, 173; humerus bone and, 173; movement of, 173, *173*; and radial muscle group, 181
Extensor carpi ulnaris muscle, 176, *176,* 273, 276
Extensor digiti minimi muscle, 175
Extensor digitorum brevis muscle, 233, 234, *234*; calcaneus bone and, 234
Extensor digitorum longus muscle, 217–18, *218*
Extensor digitorum muscle, 172, 175, *175,* 276
Extensor hallucis brevis muscle, 236
Extensor hallucis longus muscle: 218, *218*
Extensor muscles: as agonist muscles, 273; anconeus, 159; carpi radialis brevis, 273; carpi radialis longus, 273; carpi ulnaris, 273; digitorum, 273; digitorum brevis, 273; digitorum longus, 218, 273; hallucis brevis, 273; hallucis longus, 218, 273; humerus bone and, 157; illustrated, *172*; movement of, 209, 216, 218; pollicis brevis, 273; pollicis longus, 273; quadriceps muscles, 206; retinaculum ligament, 172; tibialis anterior, 216; triceps brachii, 159
Extensor pollicis brevis muscle, 177, *177*; radius bone and, 157
Extensor pollicis longus muscle, 177, *177*
Extensor retinaculum, 172, 175, 184
External: as muscle-name term, 275
External auditory meatus, 73, 106
External canthus, 102
External oblique muscle: aponeurosis of, 134; ASIS and, 135; central axis and, 135; flank pads of, 135; gender differences of, 135; iliac crest and, 134; inguinal ligament and, 44, 135; movement of, *134,* 135, *135*; pelvis and, 134; semilunar line and, 135; serratus muscle and, 134, 137; thorax and, 115, 134; xiphoid process and, 135
External occipital protuberance, 73
Extraocular muscles, 101
Extrinsic muscles, 184, 188, 233
Eye, 101–03, *101–03*
Eyebrows, 82, 83, 103, *103*
Eyelids, 84, 85, 102–03, *102–03*
Eye socket. *See* Orbicularis oculi muscle

F

Face, 53, 73–75, 101–07, *101–07*. *See also* Bones of face; Head; Muscles of head, face, and neck; Skull
Facet of bone, 55, 268
Facial bones. *See* Bones of face
False ribs, 115
Fascia: deep, 46, 267; procerus muscle and, 83; superficial, 46, 47, 77, 267; temporalis muscle and, 81
Fascicles, 64–65
Federal Committee on Anatomical Terminology (FCAT), 22
Feet. *See* Foot
Feitelson, Lorser, 11
Feltus, Alan, 15
Femoris: as muscle-name term, 276
Femur bone: acetabulum and, 203; and appendicular skeleton, 52; condyles of, 54, 202; gastrocnemius muscle and, 203, 219; gluteal muscles and, 214; illustrated, *203*; knee joint and, 205; lateral condyle of, 203, 214; linea aspera of, 203; as long bone, 53, 268; medial condyle of, 203; movement of, 202; neck of, 203; quadriceps muscles and, 208; and sartorius muscle, 210; trochanters on, 203
Fibrocartilage, 42, *42*, 121, 205, 267
Fibrous joints, 55, 56, *56*, 57, 272
Fibula bone: and appendicular skeleton, 52; illustrated, *204*; interosseous membrane and, 204; lateral malleolus and, 204; as long bone, 268; peroneal muscles and, 221; soleus muscle and, 220
Finger movements: adduction, *34*; on coronal plane, *34*, *35*; extension, *32*; of extensor digitorum muscle, 175; joints and, 58, 272
Fingers, *193*, 196–98, *196*, *198*, 272
Flank pads, 135, 214
Flat bones, 53, *53*, 268
Flat feet, 232
Flexion (movement): of adductor muscles, 211; of arm, 127; of biceps brachii muscle, 161; brachialis muscle and, 162; brachioradialis muscle and, 163; of deltoid muscle, 129; of elbow, *33*; of external oblique muscle, 135; of femur bone, 202; of flexor muscles, 168, 170, 190; of gastrocnemius muscle, 220; of head, 95; of joints, 60, 205, 224; of neck, 76, 95, *95*; of palmaris longus muscle, 169; of pectineus muscle, 211; of pronator teres muscle, 171; of rectus femoris muscle, 209; on sagittal plane, 29, 31–33, *32*, 265; of torso, 133; of vastus muscles, 209; of vertebral column, 113, 114
Flexor carpi radialis muscle, 168, *168*, 273, 276
Flexor carpi ulnaris muscle, 166, 170, *170*, 273
Flexor digiti minimi brevis muscle, 191, *191*, 273, 274
Flexor digitorum brevis muscle, 233, 236, *236*
Flexor muscles, 273; as agonist muscles, 273; biceps brachii, 159; brachialis, 159; brachioradialis, 159; carpi radialis, 273; carpi ulnaris, 273; digiti minimi brevis, 273; digitorum brevis, 273; flexion of, 220; gastrocnemius, 219; hamstring muscles and, 206; of humerus bone, 157; illustrated, *167*; of lower arm, 166; movement of, 213, 220; pollicis brevis, 273; soleus, 216, 219, 220; of thigh, 206
Flexor pollicis brevis muscle, 190, *190*
Flexor retinaculum, 166, 168, 169, 184
Floating ribs, 115
Follow-through lines, 262
Foot: abductor digiti minimi muscle of, 234, 235, *235*; abductor hallucis muscle of, 234, 235, *235*; arches of, 232, *232*; attitudes toward, 227; bones of, *229–31*; canons of, 240; creases of, 238; extensor digitorum brevis muscle of, 234, *234*; features of, *237*; flexor digitorum brevis muscle of, 236; inferior extensor rectinaculum ligament in, 237; Leonardo da Vinci on, 227; metatarsal bones of, 231; pads of, 238; phalanges of, 231; planes of, 239, *239*; plantar aponeurosis of, 237; proportions of, 240, *240*, 258; rhythms (movements) of, 227; shapes of, 227, 238, *238*, 239; skin of, 238; sole of, 238; tarsal bones of, 230; toe characteristics and, 240–41, *241*. *See also* Bones of foot; Muscles of foot
Foot movements: dorsiflexion, 38, *39*, 266; eversion, 38, *39*, 266; of extensor digitorum longus muscle, 218; of extensor hallucis longus muscle, 218; of gastrocnemius muscle, 220; hinge joint and, 272; illustrated, *39*, *216*, *218*; inversion, 38, *39*; inversion movement, 266; of peroneus brevis muscle, 221; of peroneus longus muscle, 221; plantar flexion, 38, *39*, 266; of tibialis anterior muscle, 216
Foramen of bones, 55, 268
Forefoot, 230
Fossa of bone, 55, 268
Free-form armatures, 148, 149
Freud, Lucien, 110
Frontal: as term, 276
Frontal bone, 73, *73*, 82, 269
Frontalis muscle, 82, *82*, 276
Funny bone, 157
Fusiform muscles, 66; biceps brachii, 161; brachialis, 162; extensor carpi radialis longus, 173; extensor carpi ulnaris, 176

G

Gale, Don, 15
Galen, *14*, 16, 183
Gastrocnemius muscle, 203, 219, *219*, 220, *220*, 273
Gentileschi, Artemisia, 15
Geometric armatures, 148, 149
Géricault, Théodore, 17
Glabella, 73, *73*, 103, 104
Glenoid fossa, 119; biceps brachii muscle and, 161; humerus bone and, 157; rhomboid muscles and, 141; scapula-group muscles and, 143; triceps brachii muscle and, 165
Gliding joints, 58, *59*, 272
Gluteal fold, 214, *215*
Gluteal-group muscles, 121, 206, 214, *214*, 215, *215*
Gluteus: as muscle-name term, 276
Gluteus maximus muscle, 214, *214*, 215; as agonist muscle, 273; as gluteal-group muscle, 206; hamstring muscles and, 212
Gluteus medius muscle, 214, *214*, 215; as agonist muscle, 273; as gluteal-group muscle, 206
Gluteus minimus muscle, 67, 214, 273, 274
Gomphosis joints, 55–57, *56*, 272
Goulder, Eric, 15
Gracilis muscle, 206, 210, 211, 225
Greater trochanter, 203
Greater tubercle, 157
Groin fold. *See* Inguinal ligament

H

Hallucis: as muscle-name term, 276
Hals, Frans, 110
Hamate carpal bone, 271
Hamstring-group muscles, 212, *212*, 213; as agonist muscles, 273; biceps femoris, 206; semimembranosus, 206; semitendinosus, 206; of thigh, 206
Hand: carpal bones of, 184; creases on, 197, *197*; dorsal side of, 184; drawing, 183, 194, 195; extrinsic muscles of, 184, 188; fingers of, 193, *193*, 196, 198, *198*; hypothenar muscles of, 188; illustrated, *193*; interosseous muscles of, 188, 192; intrinsic muscles of, 184, 188; joints of, *186*; muscles of, *189*; palmar side of, 184; proportions of, 194, *194*, 195, 258; retinaculum ligament in, 184; skin features of, 196, 197; thenar muscles of, 188, 197. *See also* Bones of hand; Muscles of hand
Hand grips, 198, 199, *199*
Hand movements: on coronal plane, *34*; extension, *32*; of extensor muscles, 173–76; joints and, 272; using pronator teres muscle, 171
Head, 96–99, *98*, 249. *See also* Face; Cranium; Head movement; Muscles of head, face, and neck; Skull
Head movements: on coronal plane, *35*; illustrated, *33*, *36*, *95*; joints and, 272; with sacrospinalis muscle, 125; sternocleidomastoid muscle and, 95; on transverse plane, *36*, 37
Heads of bones, 55, 268
Heel. *See* Calcaneus bone
Helix, 107
Herophilos, 16
Hindfoot, 230
Hinge joints, 272; of ankle, 272; elbow, 58–60, 158, 272; of fingers, 272; illustrated, *59*; of jaw, 272; of knee, 205, 272; temporalis muscle and, 81; of toes, 272
Hippocrates, *14*, 16, 183
Hips, 58, 120, 121, 272. *See also* Pelvis
Hook grip (hand), *199*
Hook of hamate carpal bone, 170
Humerus bone: acromion and, 157; anconeus muscle and, 165; and appendicular skeleton, 52; ball-and-socket joints and, 157, 272; biceps brachii muscle and, 157, 161; brachioradialis muscle and, 163; capitulum of, 157; deltoid muscle and, 128, 157; elbow and, 158; epicondyles of, 54, 156, 157; extensor muscles and, 173–75; extrinsic muscles and, 184; flexor muscles and, 157, 170; funny bone and, 157; glenoid fosssa and, 157; illustrated, *155*, *156*; inter-tubercular groove and, 157; latissimus dorsi muscle and, 138; as long bone, 53, 157, 268; pectoralis major muscle and, 126; pronator teres muscle and, 171; scapula-group muscles and, 142; triceps brachii muscle and, 165; trochlea bone and, 157; tubercle of, 157; ulna bone and, 157; ulnar nerve and, 157
Hyaline cartilage, 41, *41*, 267
Hyoid bone, 52, 99, 100, *100*
Hyperextension (movement): of arm, *33*, 139; of hand, 172, 175; of leg, *33*; of neck, 100; on sagittal plane, 29, 31–33, 265; of torso, *33*, 114, 125
Hypothenar muscle group, 191, *191*

I

Iliac crest, 120, 134
Iliocostalis group of sacrospinalis, 125
Iliofemoral ligament, 43
Iliotibial tract, 214
Ilium bone: as flat bone, 53, 268; iliac crest of, 120; of pelvis, 120, 121; PSIS (posterior superior iliac spine) of, 120
Incisive labii inferioris muscle, 87
Incisive labii superioris muscle, 87
Incisor teeth, 75
Inferior: as direction/location term, 29, 31, *31*, 264
Inferior angle of scapula, 119
Inferior extensor rectinaculum, 237
Inferior nasal conchae, 75, 104
Infra: as muscle-name term, 275
Infraglenoid tubercle, 165
Infrapatellar fat, 225
Infraspinatus muscle, 143, 275
Infraspinous fossa, 119
Inguinal ligament, 44, *44*, 135, 267
Inner canthus, 102
Intermediate tarsal bone, 230. *See also* Navicular bone

Intermedius muscle, 275
Intermuscular septa, 166
Internal: as muscle-name term, 275
Internal oblique muscle, 67, 273, 275
International Federation Committee of Associations of Anatomists (IFAA), 22
Inter-phalangeal joint. *See* IP joint
Interosseous ligament, 186
Interosseous membrane, 204, 217, 218, 272
Interosseous muscles, 192, *192*
Inter-tubercular groove, 157
Intervertebral discs, 42, 267
Intrinsic muscles, 184, 188, 233, 234
Inversion (movement): on coronal plane, 38; of foot, *39,* 216, 266; of tibialis anterior muscle, 216, 217
IP joint (inter-phalangeal joint), 175, 187, 196
Iris, 101, 102
Irregular bones, 53, *53,* 268
Ischial tuberosity, 120, 212
Ischium bone, 120, 121

J

Jaw, 75, 272. *See also* Mandible bone; Maxilla bones
Jaw movements: bones and, 74; depression, 38, *39*; elevation, 38, *39*; masseter muscle and, 80; protraction, 38, *39*; retraction, 38, *39*; temporalis muscle and, 81
Joint capsule: double-jointedness and, 59; of elbow, 158; synovial, 43, 58, *58,* 158, 267, 272
Joints: ball-and-socket, 58, *59,* 60, 118; biaxial, 60; capsule, 43, 58, *58,* 59, 158, 267, 272; cartilaginous, 55, *57,* 272; DIP (distal inter-phalangeal), 175; elbow, 58; ellipsoid/condyloid, 58; of foot, 231; and fibrocartilage, 42; fibrous, 55, 56, *56,* 57, 272; gliding, 58; gomphosis, 57, 272; of hand, *186,* 187; hinge, 58; hyaline cartilage in, 267; IP joint (inter-phalangeal), 175; knee, 205, 224, 225; ligaments and, 59; MCP (metacarpo-phalangeal), 175; movements of, 57, 60; PIP (proximal inter-phalangeal), 175; pivot, 58; planes of movement of, 60; saddle, 58; suture, 57, 272; symphysis, 57, 272; synchondrosis, 57, 272; syndesmosis, 57, 272; synovial, 58, *59,* 272; triaxial, 60; types of, 56–60; uniaxial, 60

K

Kahlo, Frida, 109
Key pinch (hand grip), *199*
Knee: bursae of, 225; femur condyles and, 205; gracilis muscle of, 225; illustrated, *224*; infrapatellar fat of, 225; joint, 205, *205,* 272; menisci pads and, 42; meniscus fibrocartilage of, 205, 225; movement of, *33,* 205, 224; patella bone and, 205; patellar tendon and, 224, 225; pes anserinus of, 225, *225*; planes of, *224*; popliteal fossa of, 225; proportions, 222; quadriceps muscles and, 208, 224; sartorius muscle and, 225; semitendinosus muscle and, 225; structure of, 224; tibia condyles and, 205
Knuckles. *See* MCP joint

L

Lacrimal bones, 75
Lacrimal caruncle, 102
Laryngeal prominence (Adam's apple), 100
Larynx, 41, 99, 100, *100,* 267
Lateral: as direction/location term, 23, *30,* 31, 264
Lateral cartilage, 41, 105, 267
Lateral condyle, 203
Lateral cuneiform tarsal bone, 271
Lateral epicondyle, 157
Lateral flexion (movement): on coronal plane, 29, 31, *35,* 265; of external oblique muscle, 135; of neck, 76, 95, *95*; of sacrospinalis muscle, 125; of vertebral column, 114
Lateralis: as muscle-name term, 275
Lateral longitudinal arch of foot, 232
Lateral malleolus, 204, 221
Lateral meniscus fibrocartilage, 205
Lateral palpebral ligament, 85
Lateral rotation (movement): of deltoid muscles, 129; of gluteal muscles, 215; scapula-group muscles and, 143; on transverse plane, 31, 36, *36,* 37, 265
Latissimus dorsi muscle: aponeurosis of, 138; axilla (armpit) and, 151; humerus bone and, 138; illustrated, *138*; lumbar vertebrae and, 138; movement of, 139, *139*; sacrospinalis muscle and, 125, 138; scapula and, 138, 142; serratus anterior muscle and, 136, 137; spinous process and, 138; teres major muscle and, 143; thorax and, 138
Leg: anatomical center of, 222; angles of, 222; canons of, 222, 223, *223*; curvature of, 223; knee and, 224, 225; lower, 204; muscles of, *207*; proportions of, 222, 258; rhythms of, 210, 222, 223; shapes of, 222; upper, 203. *See also* Bones of leg; Knee; Muscles of leg
Leg movements: of adductor muscles, 211; on coronal plane, *35*; extension, 209; flexion, 209; of gastrocnemius muscle, 220; of gluteal muscles, 215; joints and, 272; of quadriceps muscles, 209; of sartorius muscle, 210; of soleus muscle, 220; on transverse plane, *36*
Leonardo da Vinci, *12,* 13, 16, 227, 249
Lesser supra-clavicular fossa, 94
Lesser trochanter, 203
Lesser tubercle, 157
Levator labii inferioris muscle, 273
Levator labii superioris alaeque nasi muscle. *See* LLSAN
Levator labii superioris muscle, 88, *88*
Ligaments: annular, 158; extensor retinaculum of, 172; inguinal, 44, *44,* 267; interosseous, 186; joints and, 43, *43,* 59, 267; nuchal, 44, *44,* 267; patellar, 208, 224, 225
Linea alba, 132
Linea aspera, 203
Lips: buccinator muscle and, 92; coloring of, 86–87; depressor anguli oris muscle and, 90; depressor labii inferioris muscle and, 90, *91*; drawing, 105–06; levator labii superioris muscle and, 88; LLSAN muscle and, 86; mentalis muscle and, 90, *91*; orbicularis oris muscle and, 86–87; shapes of, 106; terms for, 87, 105; zygomaticus muscles and, 89. *See also* Mouth
LLSAN muscle (levator labii superioris alaeque nasi), 86, *86,* 273
Longissimus group of sacrospinalis, 125
Long bones, 53, *53,* 268
Longus: as muscle-name term, 274
Lumbar fascia, 125
Lumbar vertebrae, 113, 114, 138
Lunate carpal bone, 271

M

Magnus: as muscle-name term, 274
Major alar cartilage, 105
Mandible bone: buccinator muscle and, 92; coronoid process of, 74; depressor anguli oris muscle and, 90; depressor labii inferoris muscle and, 91; illustrated, *74*; as lower jaw bone, 70; masseter muscle and, 80; mental protuberance of, 75; mentalis muscle and, 91; mylohyoid muscle and, 92; temporalis muscle and, 81. *See also* Jaw
Manubrium of sternum, 94, 116, 119
Masseter muscle, 80, *80,* 92
Mastoid: as muscle-name term, 275
Mastoid process, 73, 125
Maxilla bones: buccinator muscle and, 92; dental arch of, 75; nasalis and, 85; of nose, 104; of skull, 74; as upper jaw bone, 74
Maxillary teeth, 74
Maximus: as muscle-name term, 274
MCP joint (metacarpo-phalangeal joint), 175, 187, 196
Medial: as direction/location term, 23, *30,* 31, 264
Medial cuneiform tarsal bone, 217, 271
Medialis: as muscle-name term, 275
Medial line, *26,* 27, *27, 30*
Medial longitudinal arch of foot, 232, 234
Medial malleolus, 204
Medial meniscus fibrocartilage, 205
Medial palpebral ligament, 84
Medial rotation (movement), 31, *36,* 37, 265
Medical schools, 14. *See also* Anatomical science; Dissections
Medius: as muscle-name term, 274
Menisci fibrocartilage, 225
Menisci fibrocartilage pads, 42, 267
Mentalis muscle, 90, 91, *91*
Mental protuberance, 75
Mental tubercles, 75
Mentolabial sulcus, 106
Mesomorph body type, 261, *261*
Metacarpal bones: abductor muscles and, 176; extensor muscles and, 174; features of, 186; flexor muscles and, 168, 170; as long bones, 268; as short bones, 53; of shoulder girdle, 52
Metacarpo-phalangeal joint. *See* MCP joint
Metatarsal bones: and appendicular skeleton, 52; ball of foot and, 231; elongated, 228; foot arches and, 232; of forefoot, 230; as long bones, 53, 268
Metatarsal tuberosity, 231
Michelangelo, *17,* 110
Middle cuneiform tarsal bone, 271
Middle digital crease, 197
Midfoot, 230
Midline of body. *See* Medial line
Midsagittal plane, 27. *See also* Medial line
Minimus: as muscle-name term, 274
Minor: as muscle-name term, 274
Minor alar cartilage, 105
Modiolus, 89, 90, 92
Molar teeth, 76, 92
Mouth: drawing, 105–06; mentolabial sulcus of, 106; modiolus and, 105–06; muscles of, 86–90, 92, 93, 105; nasolabial furrow of, 106; philtrum and, 87, 88, 104, 106; planes of, 106; and transitional zone of lips, 105; tubercle and, 105
Movements, anatomical: abduction, 23, 29, 31, 32, 34, *35,* 60; adduction, 23, 29, 31, 32, 34, *35,* 60; of arms, 127, 129, 138, 143, 161, 163, 165; of chin, 90, 91; circumduction, 23, 31, 37, 60; depression, 38, *39,* 266; dorsiflexion, 38, *39,* 266; elevation, 38, *39,* 266; eversion, 38, *39,* 266; extension, 23, 29, 31–33, *32, 33,* 60; of eyebrows, 82, 83; of eyelids, 84, 85; of feet, 216, 218, 220, 221; of fingers, 175, 192; flexion, 23, 29, 31, *32, 33,* 60, 95; of foot, 266; of hands, 171, 173, 174, 176; of head, 95, *95,* 125; of heel, 220; hyperextension, 32, *32, 33*; inversion, 38, *39,* 266; of jaw, 74, 80, 81; of joints, 56–60; lateral flexion, 29, 31, *35*; lateral rotation, 31, 36, *36,* 37; of legs, *35, 36,* 209–12, 214, 215, 220; of lower arm, 171; medial rotation, 31, *36,* 37; of mouth, 86, 88–93; of muscles, 66, 67, *67*; of neck, 76, 95; of nose, 85, 86; opposition, 38, *39,* 266; plantar flexion, 38, *39,* 266; protraction, 31, 38, *39,*

266; range of motion (ROM), 55, 60; reposition, 38, *39,* 266; retraction, 31, 38, *39,* 266; rolling, 60; rotation, 23, 29, 31, 37; of scapula, 137, 141; of shoulders, 118, 119; sliding, 60; spinning, 60; of thumbs, *34,* 177, *177,* 190, 191, 192, 266; of toes, 218, 234, 236; of torso, 125, 133, 135, 150, 151; of vertebral column, 114, *114*; of wrist, 168, 169, 170. *See also* Anatomical directions/locations
Multipennate muscle fibers, 66, 128
Muscle: belly of, 64; descriptive names of, 65; illustrated, *62–64*; paired, 66, 67; structure of, *64,* 65. *See also* Skeletal muscles
Muscle fibers, 66, *66*; of deltoid muscle 128
Muscles of arm, 181; abductor pollicis longus, 176, 177; anconeus, 165; biceps brachii, 159, 161; brachialis, 159, 162; brachioradialis, 159, 163; cubital fossa and, 171, 180; extensor carpi radialis brevis, 174; extensor carpi radialis longus, 173; extensor carpi ulnaris, 176; extensor digitorum, 175; extensor pollicis brevis, 176, 177; extensor pollicis longus, 176, 177; flexor, 159, 166, *167*; flexor carpi radialis, 168; flexor carpi ulnaris, 170; illustrated, *160, 172*; intermuscular septa, 166; palmaris longus, 169; pronator teres, 171; triceps brachii, 165; of upper arm, 159
Muscles of foot, 233–36
Muscles of hand, 188–92, *189*
Muscles of head, face, and neck: buccinator, 92; depressor anguli oris, 90; depressor labii inferioris, 90; digastric, 92, 93; of expression, 77; frontalis, 82; illustrated, *78, 79*; levator labii superioris, 88; LLSAN, 86; masseter, 80; mentalis, 90; mylohyoid, 92, 93; nasalis, 85; orbicularis oculi, 84, 85; orbicularis oris, 86, 87; procerus, 83; sternocleidomastoid, 94, 95; temporalis, 81; zygomaticus, 89
Muscles of leg: adductor, 206, *210,* 211; biceps femoris, 206, 213; compartments of, 216; extensor, 216–18, *217, 218*; flexor, 216, 219–20; gastrocnemius, 216, 219, *219,* 220, *220*; gluteal, 206, *214,* 215, *215*; gracilis, 206, 211; hamstrings, 206, *212,* 213; illustrated, *207*; pectineus, 206, 211; peroneal, 216, 221, *221*; quadriceps, 206, 208; quadriceps muscles and, *208, 209*; rectus femoris, 206, 209; sartorius, 206, 210, *210*; semimembranosus, 206, 213; semitendinosus, 206, 213; soleus, 216, 219, *219,* 220, *220*; tensor fascia latae, 206, 215; thigh compartments and, 206; tibialis anterior, 216, 217, *217*; vastus, 206, 209
Muscles of torso: deltoid, 128–29, *128–29*; external oblique, 134–35; illustrated, *122, 123*; latissimus dorsi, 138, 139; pectoralis major, 126, 127; rectus abdominis, 132–33; rhomboid, 140–41; sacrospinalis, 124, 125; scapula, 142, 143; serratus anterior, 136–37; trapezius, 93, 99, 128, 130, 131
Mylohyoid muscle, 92, 93, *93*
Mylohyoid raphe, 92
Myofibrils, 65
Myofilaments, 65
Myron, 110

N

Nasal bones, 74, 104, 105
Nasal cavity, 104
Nasal septum, 105
Nasal sinuses, 104
Nasalis muscle, 85, *85*
Nasion, 73
Nasolabial furrow, 106
Navicular bone, 230, 232, 271
Neck: clavicles and, 99; components of, 100, *100*; cricoid cartilage in, 100; hyoid bone in, 99, 100; joints in, 272; larynx in, 99, 100; movement of, 76; posterior triangle of, 99; sternocleidomastoid muscle and, 94, 95, 99; suprasternal notch, 100; thyroid gland in, 100; trachea in, 99, 100; triangle of, 99, *99*
Nose: alar cartilage of, 267; apex of, 105; components of, *104*; ethmoid bone in, 104; glabella in, 104; hyaline cartilage in, 41, 267; inferior nasal conchae in, 104; lateral cartilage of, 105, 267; LLSAN muscles and, 86, *86*; major alar cartilage of, 105; maxilla bones and, 104; minor alar cartilage of, 105; nasal bones of, 104, 105; nasal cavity of, 104; nasal septum of, 105; nasal sinuses in, 104; nasalis muscles moving, 85; nostrils of, 104, 105; palatine bone in, 104; planes of, 104; root of, 104; septal cartilage of, 105; shapes of, *105*; sphenoid bone in, 104; vomer bone in, 104; wing of, 105
Nostrils, 104, 105
Nuchal ligament, 44, *44,* 130, 140, 267

O

Oblique: as muscle-name term, 273
Occipital bone, 73, 95, 269
Occipital protuberance, 130
Occipito-frontalis muscle, 82
Oculi: as muscle-name term, 276
Odontoid process. *See* Dens
Olecranon process: elbow and, 158; proportions, 258; triceps brachii muscle and, 165; ulna bone and, 157
Opponens digiti minimi muscle, 276
Opponens pollicis muscle, 190, 276
Opposition (movement), 38, *39,* 190, 266
Orbicularis: as muscle-name term, 274
Orbicularis oculi muscle: depressor supercilii and, 85; eyelids, 84; frontalis muscle and, 82; illustrated, *84*; lacrimal portion of, 84; lateral palpebral ligament and, 85; medial palpebral ligament and, 84; movements of, 85; orbital portion of, 84; palpebral portion of, 84; procerus muscle and, 83, 85
Orbicularis oris muscle: buccinator muscle and, 92; illustrated, *87*; incisive labii inferioris and, 87; incisive labii superioris and, 87; lip coloring of, 87; modiolus and, 86; moving mouth, 86, 105; philtrum and, 87
Orbital cavities, 73
Orbital fat, 101
Oris: as muscle-name term, 276
Ossa coxae bones, 52
Osseous tissue, 49
Ossicle bones, 106
Ossification, 41, 49

P

Palantine bone, 75, 104
Palmar: as direction/location term, *30,* 31, 184, 264
Palmar aponeurosis, 169, 197
Palmar grip, *199*
Palmar interosseous muscles, 192, 276
Palmaris: as muscle-name term, 276
Palmaris longus muscle, 166, 169, *169,* 274, 276
Parallel muscle fibers, 66, 67
Parasagittal plane (paramedian plane), 29
Parietal bones, 73, 269
Patella bone, 222. *See also* Knee
Patellar ligament, 208, 224. *See also* Knee
Pectineus muscle, 206, 211
Pectoralis major muscle, 126, *126,* 127, *127,* 137, 151, 274
Pectoralis minor muscle, 274
Pelvic girdle, 52
Pelvis: anatomical center of, 121; ASIS (anterior superior iliac spine) of, 120; coccyx bone in, 121; external oblique muscle and, 134; gender differences in, 121; gluteal muscles and, 214; hip bones in, 120, 121; iliac crest of, 120; ilium bone in, 120, 121; illustrated, *120*; ischial tuberosity in, 120; ischium bone in, 120, 121; landmarks of, *121*; PSIS (posterior superior iliac spine) in, 120, 121; pubic symphysis in, 42, 121; pubis bone in, 120, 121; quadriceps muscles and, 208; sacrospinalis muscle and, 125; sacrum in, 120, 121; symphysis joint in, 272; and torso, 110
Pelvis axis, 144, *145*
Pennate muscle fibers, 66, 67
Permanent cartilage. *See* Fibrocartilage; Hyaline cartilage
Peroneal-group muscles, 221
Peroneus brevis muscle, 221, *221,* 274
Peroneus longus muscle, 221, *221,* 274
Pes anserinus, 210, 225, *225*
Phalanges of fingers, 175, 186. *See also* Fingers
Phalanges of toes, 228, 230, 231, *231,* 240. *See also* Toes
Philtrum, 87, 88, 104, 106
PIP joint (proximal inter-phalangeal joint): defined, 187; extensor digitorum muscle and, 175; of fingers, 196; middle digital crease at, 197
Pisaform carpal bone, 170, 271
Pivot joints, 58, *59,* 60, 272
Planes: anatomical, 28; defined, 264; in drawing, 246; of foot, *239*; of head, 96, 97, *97*; horizontal, 121; of knee, *224*; of mouth, 106, *106*; of nose, 104, *104*; of reference, 28; of scapula, 119; of section, 28; of sternum, 116. *See also* Coronal plane; Sagittal plane; Transverse plane
Plantar: as direction/location term, *30,* 31, 264
Plantar aponeurosis, 237
Plantar flexion (movement): on coronal plane, 38; of foot, *39,* 220, 231, 266; gastrocnemius muscle and, 220; peroneus brevis muscle and, 221; peroneus longus muscle and, 221; soleus muscle and, 220
Pollaiuolo, Antonio, 16
Pollicis: as muscle-name term, 276
Polyclitus, 249
Popliteal fossa, 212, 225, *225*
Posterior: as direction/location term, 27, 31, 264; as muscle-name term, 275
Posterior border, 157
Posterior compartment, 206, 216, 219, 220
Posterior superior iliac spine. *See* PSIS
Posterior triangle, 99
Praxiteles, 109
Precision grips, 198, *199*
Premolar teeth, 76
Presternum. *See* Manubrium
Procerus muscle, 83, *83,* 85
Process of bone, 55, 268
Pronation (movement): brachioradialis muscle and, 163; defined, 273; of pronator teres muscle, 171; on transverse plane, *36,* 37, 265
Pronator teres muscle, 166, 171, *171,* 273
Proportions: of arm, 179, *179,* 258; body heights and, 260, *261*; body widths, 259; 8-heads system of, *252,* 253; facial, 96; in fashion, 250; of foot, 240, *240,* 258; halves, *98, 256,* 257; of hand, 194, *194,* 258; of head, 97, *98,* 249; history of, 249; of leg, 222, *223,* 258; Leonardo da Vinci and, 249; 7½-heads system of, 249, 254, *255*; skeletal, 49; thirds, *98,* 250, *256,* 257; of torso, 144, 146, *146,* 147, *147,* 179, *179. See also* Canons

Protraction (movement): defined, 266; illustrated, *39*; of jaw, 38, *39*; of shoulders, 38, *39*, 117, 118, 119; on transverse plane, 31, 38
Protrusion. *See* Protraction, of jaw
Protuberance of bone, 55, 268
Proximal digital crease, 197
Proximal: as direction/location term, *30*, 31, 264
Proximal inter-phalangeal joint. *See* PIP joint
PSIS (posterior superior iliac spine), 120, 121, 144, 146
Pterygo-mandibular raphe, 92
Pubic symphysis, 121, 267
Pubis, 120, 121, 132
Pubofemoral ligament, 43
Pupil, 102

Q

Quadriceps muscles: as agonist muscles, 273; femur bone and, 208; gluteal muscles and, 214; knee joint and, 224; movement of, 208, *208*, 209, *209*; patella bone and, 208; patellar ligament and, 208; pelvis and, 208; rectus femoris, 206, 209; of thigh, 206; tibia bone and, 208; vastus, 206, 209
Quadrilateral muscles, 88, 90

R

Radialis: as muscle-name term, 275, 276
Radial muscle group, 181
Radial tuberosity, 157, 161
Radius bone: abductor muscles and, 157, 176; and appendicular skeleton, 52; biceps brachii muscle and, 157, 161; brachioradialis muscle and, 163; elbow and, 158; extensor muscles and, 157; extrinsic muscles and, 184; illustrated, *155*, *156*; as long bone, 53, 268; pronator muscles and, 171; radial tuberosity of, 157; styloid process of, 157
Ramus of mandible, 74, 80
Range of motion (ROM), 55, 60, 66
Rectus: as muscle-name term, 273
Rectus abdominis muscle, 132, *132*, 133, *133*, 276
Rectus femoris muscle: defined, 273; of quadriceps muscles, 206, 208, 209
Reposition (movement), 38, *39*, 266
Retraction (movement): defined, 266; of jaw, 38, *39*; of shoulders, 38, *39*, 117–19; on transverse plane, 31, 38
Retrusion. *See* Retraction, of jaw
Rhomboid: as muscle-name term, 274
Rhomboid muscles, 140, *140*, 141, *141*, 274
Rhythms (movements): of body, 262, *262*, 263, *263*; of feet, 227; of fingers, 196, *196*; follow-through lines, 262; of legs, 210, 222, 223, *223*; line of action in, 262; as tempo changes, 67; of toes, 240, 241, *241*
Ribcage. *See* Thorax
Ribs, 115, *115*; as flat bones. *See also* Thorax
Rolling movements, 60
Root of nose, 104
Rotation (movement): of arm, 127, 139; of deltoid muscle, 129; of external oblique muscle, 135; of femur bone, 202; joints and, 60; of neck, 76; of rhomboid muscles, 141; scapula-group muscles and, 143; of serratus anterior muscle, 137; of shoulders, 118, 119, 131; of torso, 23; on transverse plane, *36*; of vertebral column, 114
Rotator cuff muscles, 143
Rubens, Peter Paul, 109

S

Sacrospinalis muscle: iliocostalis group of, 125; illustrated, *124*; latissimus dorsi muscle and, 125, 138; longissimus group of, 125; lumbar fascia and, 124, 125; mastoid process and, 125; movement of, 125, *125*; rhomboid muscle and, 125, 140; spinalis group of, 125; terminology of, 276; thorax and, 124, 125; trapezius muscle and, 125; vertebral column and, 125
Sacrum, 113, 114, 120, 121
Saddle joints, 58, *59*, 60, 272
Sagittal plane: defined, 264; features of, 28, *28*, 29, *29*; medial line on, *30*; movement on, 31–33, *32*, *33*, 265; parasagittal plane and, 29; synonyms for, 264
Sartorius muscle, 210, *210*, 225
Scaphoid carpal bone, 271
Scapula: acromion (acrimonial process) of, 119; ball-and-socket joints and, 119, 272; biceps brachii muscle and, 161; clavicles and, 119; coronoid process of, 119, 161; deltoid muscle and, 128–29; as flat bone, 53, 268; glenoid fosssa of, 119; inferior angle of, 119; infraspinous fossa of, 119; latissimus dorsi muscle and, 138; medial border of, 119; movement of, 118, *118*, 119; muscles of, 142, *142*, 143, *143*; plane of, 119; rhomboid muscle and, 141; serratus anterior muscle and, 136, 137; and shoulder girdle, 52, 119; spine of, 119; supraspinous fossa of, 119; trapezius muscle and, 131; triceps brachii muscle and, 165; and vertebral column, 119
Schmidt, Edward, 15
Schola Medica Salernitana, 16
Sclera, 101
Semilunar line, 135
Semimembranosus muscle, 206, 213
Semitendinosus muscle: features of, 213; hamstring muscle and, 206; of knee, 225; sartorius muscle and, 210
Septal cartilage, 105
Serra: as muscle-name term, 274
Serratus anterior muscle: axilla (armpit) and, 151; external oblique muscle and, 135, 137; latissimus dorsi muscle and, 136, 137; movement of, *136*, 137, *137*; pectoralis major muscle and, 137; scapula and, 136; as serra-shape muscle, 274; thorax and, 136
Sesamoid bones, 53, 268
Seven-and-a-half-heads system of proportions, 249, 254, *255*, 260
Shin, 204. *See also* Tibialis anterior muscle
Short bones, 53, *53*, 268
Shoulder axis, 144, *145*
Shoulder girdle: of appendicular skeleton, 52; ball-and-socket joints in, 272; clavicles and, 52, 119; and deltoid muscle, 128; humerus bone in, 52; illustrated, *119*; scapula and, 52, 119
Shoulder movements, 38, *39*, 58, *59*, 272
Signorelli, Luca, 16
Skeletal arch (anatomical arch), 115
Skeletal armatures, 148, 149
Skeletal muscles, 61, 64, 65
Skeleton: appendicular, 52, *52*; axial, 52, *52*; bone features of, 55; bone shapes of, 53; bone tissues of, 49; cranium proportions of, 49; illustrated, *50*, *51*; joints of, 56–60; ossification of, 41, 49. *See also* Bones
Sketches. *See* Drawing
Skin, 196, 197, 238
Skull. *See* Bones of skull
Sliding movements, 60
Sling of the digastric, 93
Smooth muscles, 61
Snuffbox muscles, 157, 181, *181*
Solea: as muscle-name term, 274
Sole of foot, 238
Soleus muscle, 219, *219*, 220, *220*, 273, 274
Sphenoid bone, 73, 104, 269
Spina: as muscle-name term, 276
Spinalis group of sacrospinalis, 125
Spine: of bone, 55, 268; of scapula, 119. *See also* Vertebral column
Spinning movements, 60
Spinous process, 113, 130, 138
Spongy bone tissue, 49
Stabilizer muscles, 66, 67
Sternal angle, 116
Sternal head, 94
Sterno: as muscle-name term, 275
Sternocleidomastoid muscle, 94, *94*, 95, *95*, 99
Sternum: body of, 116; clavicle bone and, 116; as flat bone, 53, 268; illustrated, *116*, *117*; manubrium of, 94, 116; plane of, 116; sternal angle of, 116; sternocleidomastoid muscle and, 94, 95; synchondrosis joint in, 272; of thorax, 115; xiphoid process of, 116
Styloid process, 157, 163
Subcutaneous fat, 47, 267. *See also* Adipose tissue
Superciliary arches, 73
Superficial fascia, 267
Superior: as direction/location term, 29, 31, *31*, 264
Superior nuchal line, 95
Superior temporal lines, 73
Supination (movement): of biceps brachii muscle, 161; brachioradialis muscle and, 163; on transverse plane, *36*, 37, 265
Supinator: as muscle-name term, 273
Supra: as muscle-name term, 275
Supraglenoid tubercle of scapula, 161
Supraspinatus muscle, 143, 275
Supraspinous fossa, 119
Suprasternal notch, 94, 100, 117
Suture joints, 56, *56*, 57, 272
Symphysis joints, 56, 57, *57*, 272
Synchondrosis joints, 56, 57, *57*, 272
Syndesmosis joints, 55–57, *56*, 272
Synergist muscles, 66, 67
Synovial fluid, 58
Synovial joints: ball-and-socket, 58–60, *59*, 272; joint capsule of, 58, *58*; of elbow, 58; ellipsoid/condyloid, 58–60, *59*, 272; fluid of, 58; gliding, 58, *59*, 272; hinge, 58–60, *59*, 272; of knee, 205; and ligaments, 43, *43*, 267; membrane of, 58–60; pivot, 58, *59*, 272; saddle, 58–60, *59*, 272
Synovial membrane, 58, 158
Synovial sheaths, 172

T

TA *(Terminologia Anatomica)*: defined, 22, 277
Tail bone. *See* Coccyx bone
Talus tarsal bone, 204, 232
Tarsal bones: anterior, 231; and appendicular skeleton, 52; calcaneal tuberosity of, 230; calcaneus, 230, 232; cuboid, 230; cuneiform, 230, 231; distal row of, 230; of hindfoot, 230; intermediate, 230; of midfoot, 230; movement of, 231; navicular, 230; plane joints of, 231; proximal row of, 230; as shock absorbers, 228, 230; as short bones, 53, 268; talus, 230
Tear ducts, 102
Teeth, 75, *75*, 76, 272
Temporal: as muscle-name term, 276
Temporal bones, 73, 269
Temporalis muscle, 81, *81*, 276
Temporary cartilage, 41
Temporo-mandibular joint. *See* TMJ
Tendons: aponeuroses, 64; attaching to, 64; muscles and, 64–66, 81, 175; patellar, 224, 225; purpose of, 45, *45*, 267
Tensor fascia latae muscle, 206, 214, 215
Teres major muscle: axilla (armpit) and, 151; latissimus dorsi muscle and, 143; as major muscle, 274; scapula and, 143
Teres minor muscle, 143, 274
Terminologia Anatomica. *See* TA
Thenar muscle group, 189–91, *190*
Thirds of the head, 98, *98*, 99
Thoracic arch, 115, 267
Thorax: abdominal arch (Greek arch), 115; of axial skeleton, 52; axilla (armpit) and, 151; and

costal cartilage, 115; external oblique muscle and, 135; flat bones in, 268; illustrated, *115*; latissimus dorsi muscle and, 138; ribs of, 115; sacrospinalis muscle and, 124, 125; serratus muscle and, 136; skeletal arch and, 115; sternum in, 115; synchondrosis joint in, 272; thoracic arch in, 115; of torso, 110; vertebrae of, 113–15
Three-point chuck (hand grip), *199*
Thumb, 177, *177*, 272
Thumb movements: on coronal plane, 32, *34*; opposition, 38, *39*, 266; reposition, 38, *39*, 266; saddle joint and, 272; using abductor muscles, 177, 190, 191; using adductor muscles, 190, 191; using extensor muscle, 177; using flexor muscles, 190, 191; using opponens muscles, 190, 191
Thyroid cartilage, 100
Thyroid gland, 100, *100*
Tibia bone: anterior crest of, 204; and appendicular skeleton, 52; condyles of, 202, 204; extensor digitorum longus muscle and, 218; illustrated, *204*; knee joint and, 205; lateral condyle of, 204; as long bone, 53, 268; medial malleolus and, 204; sartorius muscle and, 210; shinbone and, 204; talus tarsal bone and, 204; tibial tuberosity of, 204; tibialis anterior muscle and, 217
Tibialis: as muscle-name term, 276
Tibialis anterior muscle, 216, 217, *217*, 275, 276
Tibialis posterior muscle, 275
Tibial tuberosity, 204, 208
Tip-to-tip pinch (hand grip), *199*
TMJ (temporo-mandibular joint), 74
Toe movements: on coronal plane, *34*, *35*; hinge joint and, 272; using abductor muscles, 234; using extensor muscles, 218, 234
Toes, 240, 241, *241*, 272. *See also* Bones of foot; Foot; Muscles of foot
Torso: armature drawings of, 148, 149; ASIS and, 144; axes of, 144, *145*; axilla (armpit) of, 151; canons of, 146, 147; central axis of, 144, *145*, 150, 151; external oblique muscle and, 135; female, 109; illustrated, *111*, *112*; male, 109–10; movement of, *33*, *35*, *36*, 150; pelvis axis of, 144, *145*; proportions, 146, *146*, 147, *147*; PSIS and, 144; rectus abdominis muscle moving, 133; relation to arm, 179, 180; shape designs of, 148, 149; shoulder axis of, 144, *145*; transverse plane movements in, *36*, 37. *See also* Bones of torso; Muscles of torso
Trachea: hyaline cartilage in, 41, *41*, 267; C rings of, 100; illustrated, *100*; and triangles of neck, 99, 100; thyroid gland surrounding, 100
Tragus, 107
Transverse: as muscle-name term, 273
Transverse plane: defined, 264; features of, 28, *28*, *29*; movement on, 31, 36–38, *36*, 265; synonyms for, 264
Transverse process, 113
Trapezium carpal bone, 271
Trapezius muscle: acromion and, 130; clavicle and, 130; deltoid muscle and, 128; digastric muscle and, 93; movement of, *130*, 131, *131*; mylohyoid muscle and, 93; and neck, 99; nuchal ligament and, 130; occipital protuberance and, 130; portions of, 130, 131; rhomboid muscle and, 140; sacrospinalis muscle and, 125; scapula and, 131, 142; spinous process and, 130; supraspinatus muscle and, 143; trapezius muscle and, 130; upper portion of, 130, 131
Trapezoid carpal bone, 271
Triaxial joint, 60
Triceps brachii muscle: brachialis muscle and, 162; deltoid muscle and, 165; features of, 164, *164*; glenoid fossa and, 165; humerus bone and, 165; and infraglenoid tubercle of scapula, 165; movement of, *165*; scapula and, 165; of upper arm, 159
Triceps surae muscle, 219
Triquetral carpal bone, 271
Trochanter of bone, 55, 268
Trochlea of bone, 55, 157, 158, 268
Trochlear notch, 157
True ribs, 115
Tubercle of bone, 55, 105
Tuberosity of bone, 55, 268

U

Ulna bone: abductor muscle and, 176; coronoid process of, 171; elbow and, 157, 158; extrinsic muscle and, 184; flexor muscles and, 170; furrow of, 157, 176; humerus bone and, 157; illustrated, *155*, *156*; as long bone, 53, 268; olecranon process of, 157; posterior border of, 157; of shoulder girdle, 52; styloid process of, 157; trochlear notch of, 157
Ulnaris: as muscle-name term, 140
Ulnar nerve, 157
Uniaxial joint, 60
Unipennate muscle fibers, 66, 192

V

Vastus: as muscle-name term, 274
Vastus intermedius muscle: as agonist muscle, 273; movement of, 209; of quadriceps muscles, 206, 208, 209
Vastus lateralis muscle: as agonist muscle, 273; movement of, 209; of quadriceps muscles, 206, 208, 209
Vastus medialis muscle: as agonist muscle, 273; movement of, 209; of quadriceps muscles, 206, 208, 209
Vertebrae: atlas of, 76; of axial skeleton, 52; axis, 76; cervical, 76, *76*; dens of, 76; intervertebral discs and, 42; as irregular bones, 53, 268; of neck, 76, *76*
Vertebral arch, 113
Vertebral column: atlas of, 113; body (centrum) of, 113; cervical region of, 113, 114; contrapposto position of, 114, *114*; illustrated, *113*; lumbar region of, 113, 114; movement of, 113, 114; ribs of, 115; sacrospinalis muscle and, 125; sacrum region of, 113, 114; and scapula, 119, 142; spinous process of, 113; thoracic region of, 113, 114; of torso, 110; transverse process of, 113; vertebral arch of, 113. *See also* Torso
Voice box. *See* Larynx
Volar: as direction/location term, 31, 264
Vomer bone, 75, 104

W

Windpipe. *See* Trachea
Wings of nose, 105
Wrist movements, 168–70
Wrists, 272

X

Xiphoid process: attachments of, 77; features of, 134–35; lateral flexion of, 135; sternum and, 116, 132

Z

Zygomatic arch, 73, 74, 80, 81
Zygomatic bones, 73, *73*
Zygomaticus muscles, 89, *89*